Smart applications

The future of applications

wipro

Contents

Foreword

We are in the midst of an epic shift where digital disruption and innovation at speed will transform customer and employee experiences. Technology and applications will obviously play a pivotal role in creating new benchmarks for how solutions are developed and services are delivered. Expectations from stakeholders across the value chain (external and internal to organizations) have changed dramatically and they want applications that understand them, respond to them, and even proactively suggest actions and alternatives. They seek smart and seamless experiences.

While 'as-a-service', cognitive automation and cloud native development become mainstream as a part of this shift, it will be critical for organizations to leverage the right platforms and build industry-specific solutions. As an example, there is now wider acceptance for conversational artificial intelligence and prescriptive insights at an enterprise level, but there is still significant headroom to realize the value of the internet of things and blockchain use cases as part of the innovation continuum. Add to this the imperative of having security assurance embedded in applications to minimize risks and vulnerabilities, but also intelligently respond to threats. In short, while applications become smarter, the process and technology complexity required to make that happen cannot be neglected.

We need to make our applications smarter, proactive and personalized. By reimagining processes, powering them with intelligent process automation, infusing our platforms with artificial intelligence and making security systems more adaptive, applications can deliver unforgettable experiences. This in turn, will lead to smarter business outcomes such as smarter products, smarter cities, smarter assets, etc.

The report, **Smart applications—the future of applications,** provides all the rules of engagement and supporting pillars you need in the pursuit of customer delight.

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Preface

Smart applications are inevitable. We as users are already experiencing the power of what smart applications can do in our daily lives. Be it real time traffic congestion alerts, highly personalized news feeds, aptly targeted product recommendations or asking an Alexa or Cortana (or your favorite virtual assistant) to order daily groceries; these experiences are conversational, they feel natural, they are able to figure out intent, they are predictive, and are uncannily prescient. These experiences are raising the bar on what we expect at work or when we interact with a business as customers. We are at the tipping point and will soon see smart applications proliferate into all industries such as banking, retail, utilities, manufacturing, healthcare, telecom, transport, travel and media.

Technologies like machine learning, artificial intelligence, intelligent automation, mixed reality, cloud native computing and internet of things are supercharging applications with intelligence, to become 'smart' and exhibit the same attributes as smart humans. Technology and platform providers are innovating and readying their platforms with capabilities that will help build smart applications.

This report, **Smart applications—the future of applications**, is an effort to bring together a coherent view and make sense out of the direction applications are taking. As an increasing number of executives are mandated to create applications that reduce the friction between machines and humans and deliver convenience, they will need to bring a structured approach to the solutions they create. In this report, we delve under the skin of technologies and boil them down to the imperatives an organization must address in order to quickly and successfully create the new generation of smart applications. It provides insights into the approach, structure, technologies, processes and foundational capabilities required to make smart applications a reality.

This report has come together through insights drawn from our internal research, conversations with clients, and understanding of the technology innovations in our ecosystems. In theory, this report should serve as a handy primer to the era of smart applications.

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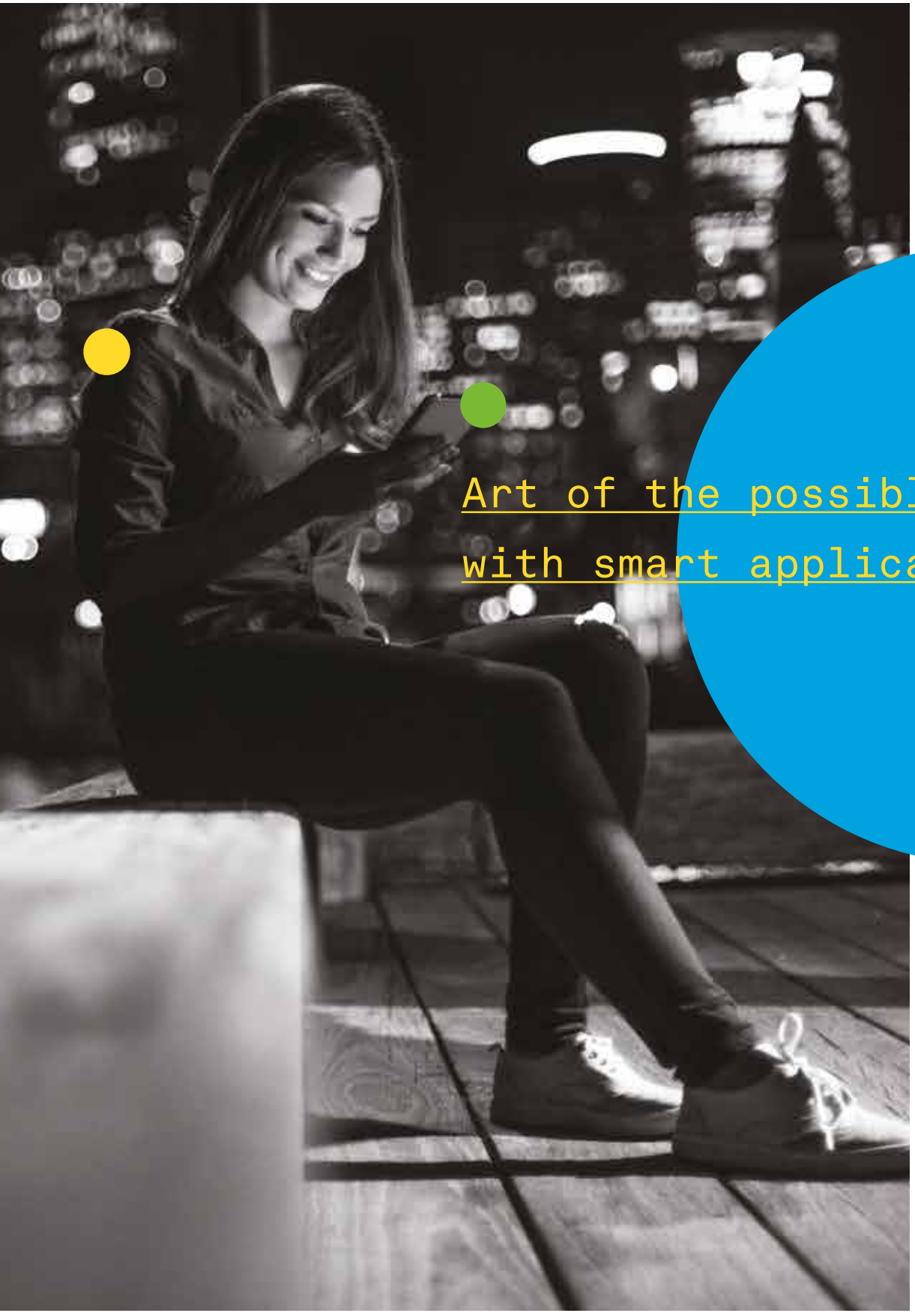

Art of the possible with smart applications

Applications today have become more effective and efficient than, say, they were a decade ago. They take commands from the users and meticulously execute them, over and over again; they work faster and they crash less often; they work on a variety of platforms and devices; they power millions of businesses every day to run their operations successfully; and many have become extremely affordable.

It isn't surprising that employees and customers have begun to expect more from their applications. But, it isn't just affordability, usability, speed or reliability they are looking for. They want their applications to be smart, intelligent, aware and prescient. The questions, therefore, to ask are: Are applications exploiting the art of the possible? Can they provide what users expect? Can they display 'intelligence'—for example, can a banking application suggest ways to limit spending or optimize taxes? Can it tell us where to invest based on our needs? Can a shopping application figure out that you are vegan or lactose intolerant and reshape the storefront accordingly? By contrast, have you noticed how an e-commerce site keeps suggesting products long after you have bought them? Or a banking application notifies you of insufficient funds only after you have finished filling in all the details for a money transfer? These are indications that applications have a long distance to go before they become truly smart.

With a large range of smart devices—like smart phones and wearables—which are packed with sensors and guide us proactively, it would be natural to expect that our applications become smart as well.

What do we mean by 'smart'? When we understand the intent of others based on a variety of clues such as speech and emotions, body language, and environmental and social context, we call it 'being smart'. Can applications do the same? We believe technology is ready to deliver truly smart applications—the ones that understand user intent without having to wait for checkboxes to be ticked or screens to be tapped. Technology disruptions like big data, mixed reality (MR), robotics, machine learning (ML), artificial intelligence (AI), cloud, cognitive computing, mobility, internet of things (IoT) and blockchain that didn't exist until some years ago, are redefining the art of the possible (see Figure 1).

The questions to ask are: Are applications exploiting the art of the possible? Can they provide what users expect? Can they display 'intelligence'?

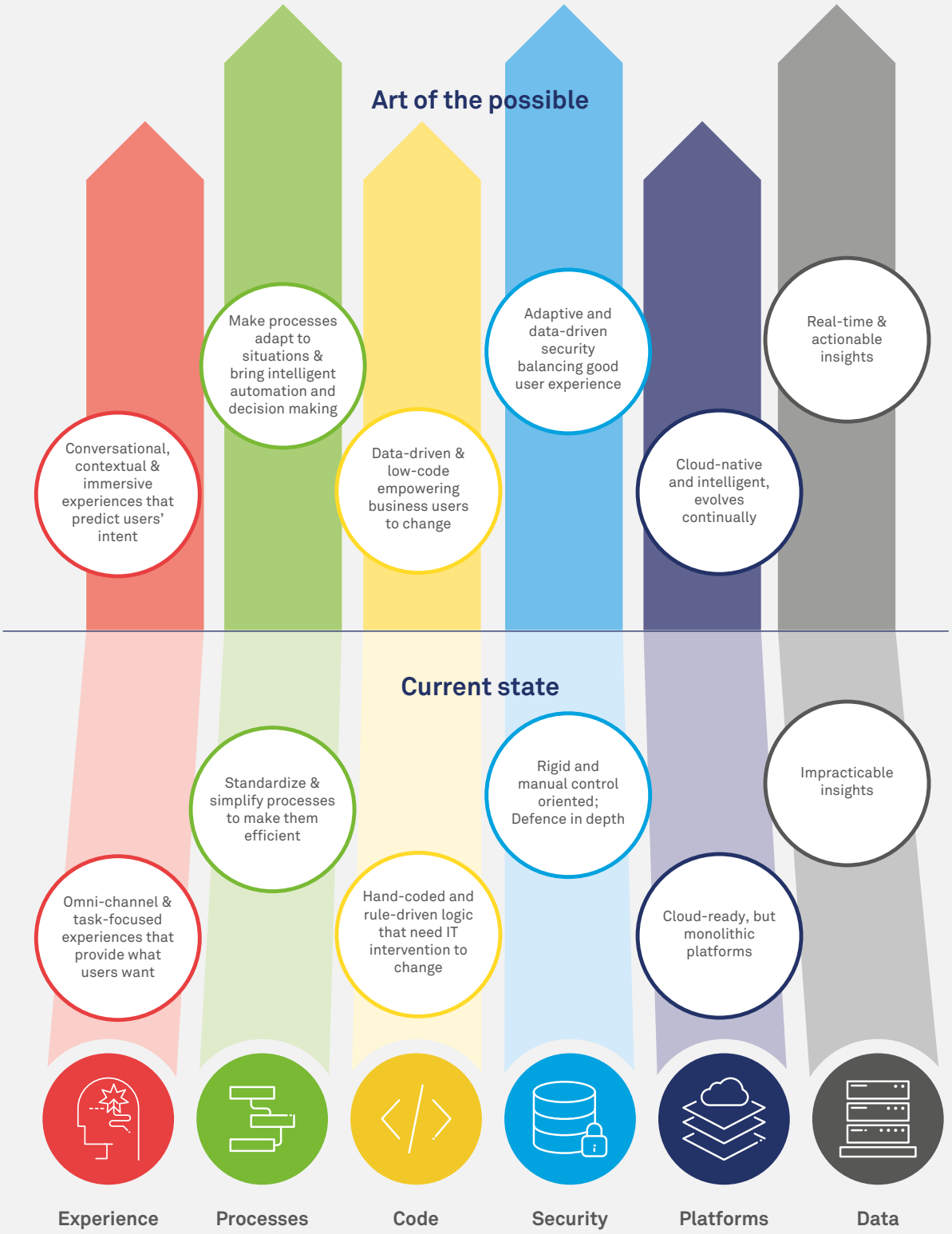

Figure 1: Art of the possible for applications

Libratus, an AI system playing poker at Carnegie Mellon University, mastered over 316,000,000,000,000,000 different situations in weeks to beat four top human professional players. Libratus demonstrated that it isn't only humans who can bluff or take a chance and win—AI can do a better job. Think of MRI scanners that can perform better than any radiologist because they have access to more data than any radiologist can crunch. Think of a travel application that summons a taxi at the right moment without a prompt. The new breed of technologies, when made to work in concert, can decipher human intent, even outguess us, and act intelligently on our behalf.

We are steadily moving into a new era of smart applications (see Figure 2).

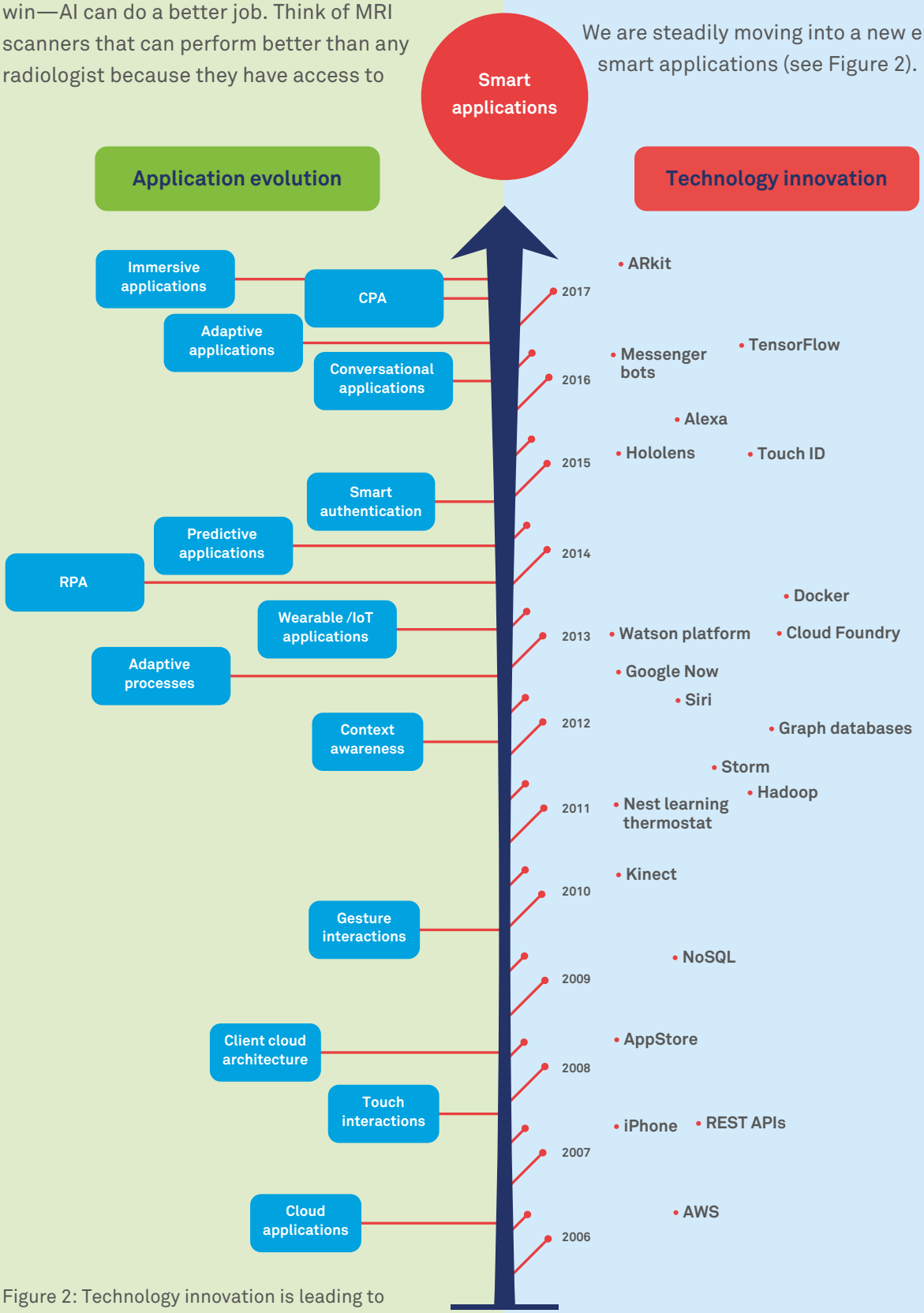

Figure 2: Technology innovation is leading to the new era of smart applications

1.1 Anatomy of smart applications

Smart applications exhibit the same attributes as smart humans. They are aware, intelligent and autonomous (see Figure 3).

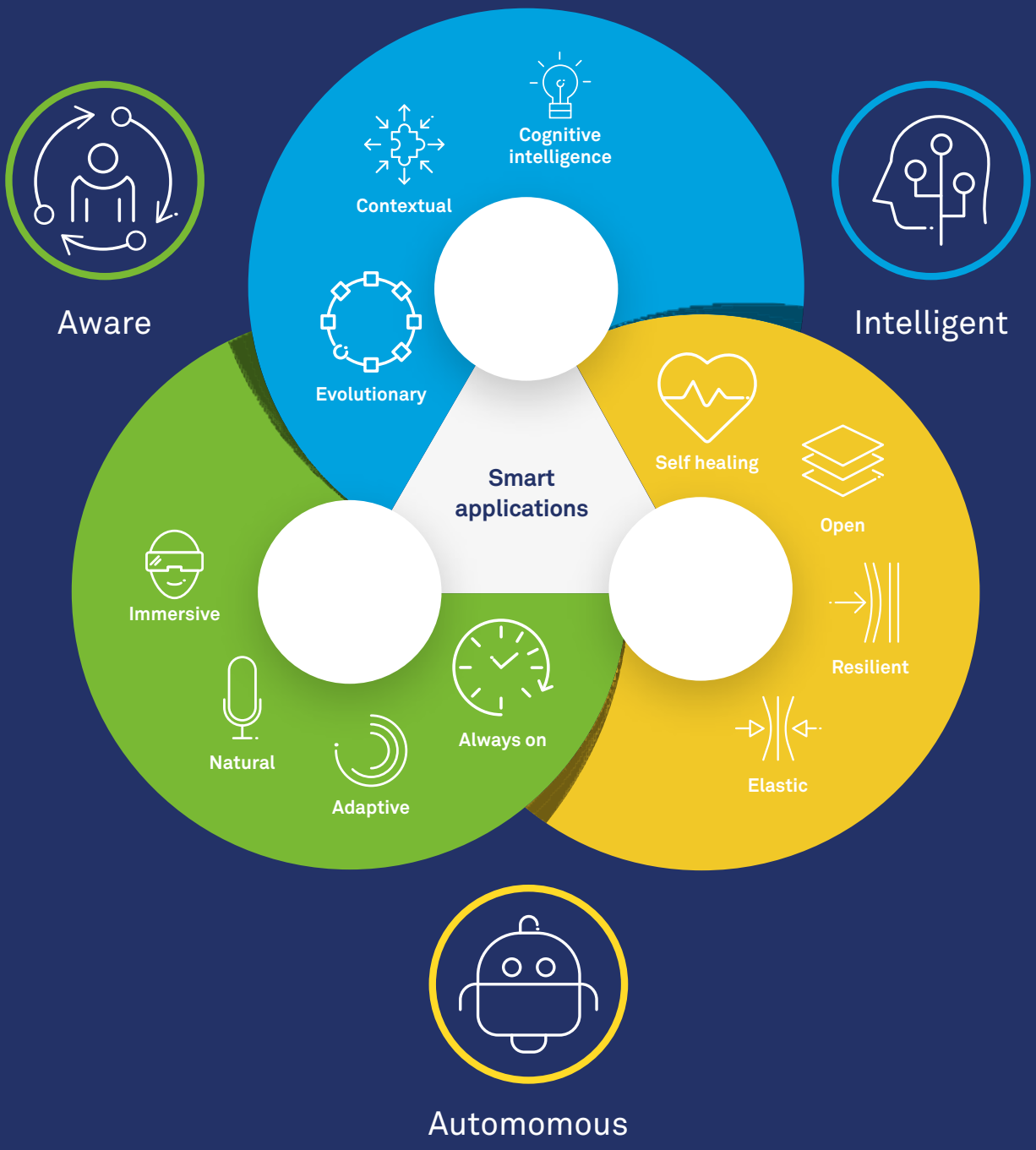

Figure 3: Attributes of smart applications

As a consequence, smart applications are:

Aware- Reimagine how users interact: Smart applications constantly learn and are fully aware of users, devices and environments. This helps them deliver a natural and humanized experience.

Intelligent- Redefine how businesses work: They leverage cognitive and contextual intelligence. This helps create clever business processes, cut down process time and automate manual touchpoints. Smart applications know the exact moment when interventions are required, when to take decisions and when to execute interactions/transactions.

Autonomous- Self-manage problems: They are autonomous, elastic and resilient. They can self-diagnose snags and glitches and then self-heal.

Smart applications are already firing the imagination of industries with new possibilities. Assisted surgery, autonomous cars, and safer mining operations are part of this trend. But, silently, they are also doing other less glamorous everyday tasks. They are speaking to customers and offering advice, answering questions about products, fixing delivery schedules and making sure our homes are safe and run optimally.

Technology to enable this is becoming affordable. The bad news is that, in a trice, you can get lost in the technological euphoria and not make headway fast enough.

Technology to enable smart applications is becoming affordable. The bad news is that, in a trice, you can get lost in the technological euphoria and not make headway fast enough.

The 4 smart imperatives

Smart applications cannot be built by simply harnessing technology. They require a more comprehensive view of how users interact with applications, the platforms that bring them to life and how new business processes and workflows impact an organization. This calls for a structured approach to build this new generation of applications. We call them **the 4 smart imperatives** (see Figure 4).

These imperatives converge, allowing smartness to seep into every aspect of applications, making them better—and more intelligent—than anything you have had in the past.

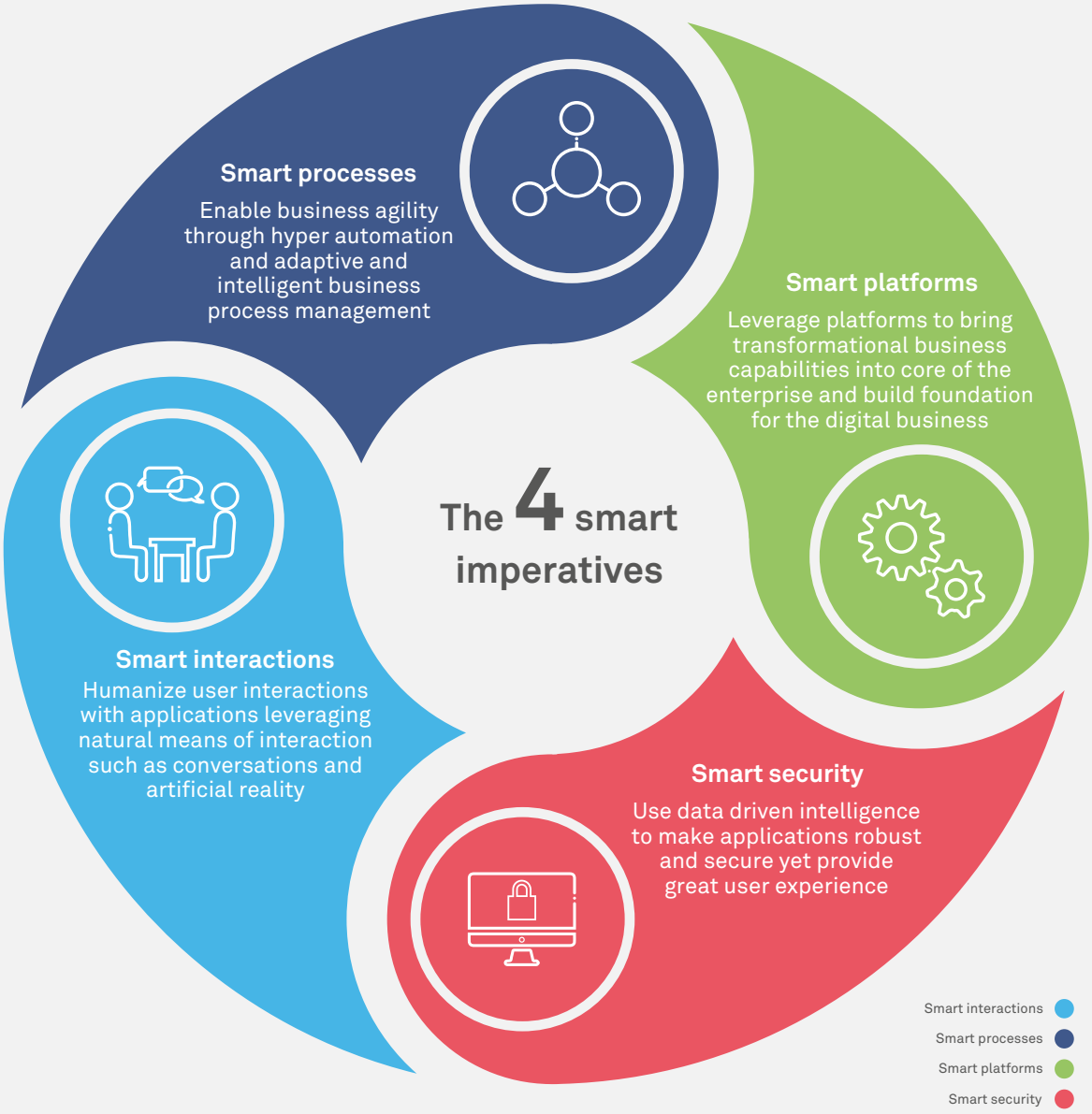

Figure 4: The 4 smart imperatives

Smart interactions

We often interact with applications in isolation, opening one application after another to take decisions and to complete tasks. Now imagine a conversation with your doctor. In the world that we foresee, that conversation can be understood and automatically turned into scheduled hospital appointments, alerts to caregivers, payers and patient monitoring systems, without having to deal with separate applications. Such unmediated actions are the outcome of AI, data sciences, analytics and cognitive computing. They make our interactions accurate and friction-free.

At the moment, there are **four technological building blocks** that determine how we make this happen:

- Conversational applications
- Multi-modal interfaces
- Mixed reality
- Contextual interfaces

Conversational applications[1]: Conversational interfaces are the first step in humanizing applications. They allow users to conduct conversations with applications using voice or text, in roughly the same way as the user would have conversed with a fellow human. Using speech and natural language recognition, either through text or voice, makes it easier for users to interact with applications. Voice-based interactions are gaining traction. Siri, Alexa, Google Now and Cortana are leading the way. Research suggests that 50% of searches will be voice based by 2020[i]. Talking to a device without a screen as an interface simplifies interaction and delivers extreme improvement in experience.

Chatbots using text are also becoming highly popular in industries such as travel and banking. Users can type in what they want and the bot offers information, advice and action based on parameters such as user profile, demographics, location and language. A sophisticated banking chatbot can easily handle a text message like, "Send $20 to Maggie to cover her dinner bill." The inbuilt smartness would make the bot respond, "Which account should I send it from? Your checking account or the savings account?" Or the chatbot may ask, "Do you want it sent to your sister Maggie or to the babysitter?" In effect, a bot could carry out instructions using free-flowing natural conversations.

Multi-modal interfaces[1]: Multi-modal interfaces use a combination of input and output mechanisms to create smart interactions in applications. Amazon's Echo Show leverages multi-modal interfaces in a simple, but effective manner. The device combines a screen and a voice interface. When asked for directions, Echo Show speaks them out and shows the map on its screen.

Mixed reality[2]: Mixed reality (MR) refers to a spectrum of technologies that include augmented reality (AR), virtual reality (VR) and augmented virtuality (AV). These technologies merge the virtual and the real worlds to create immersive experiences. By using MR, a shopper can try on different apparels without actually having to change: a smartphone would use an image of the shopper to drape clothes from a catalogue.

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Contextual interfaces[2]: The ability to understand and predict a user's intent is the key to successful contextual interfaces. These interfaces analyze data from diverse sources to decipher intent and then adapt the interface to

[1] *For more information, see page 37*
[2] *For more information, see page 38*

assist the user achieve the intent more easily. Often, an application has features or capabilities that overwhelm the user. Applications with smart interfaces can take contextual cues to enable/disable and personalize features to simplify interactions. For instance, an operations manager at an airport using a device for check-ins would see the interface that assists with check-ins. This interface would automatically change when the manager moves to the luggage area, the security area or the boarding gate. At each of these locations, the device would intuitively switch to the appropriate interface to help accomplish the relevant tasks[ii]. Such a contextualized experience ends up improving both worker and customer experience.

Smart processes

Workflow management, process adherence (increasingly for compliance) and efficiency are critical to business. But what happens when customer expectations of how businesses respond to their requirements change? What happens when processes consume an inordinate amount of time or resources resulting in customer dissatisfaction and costs? In both instances, the normal response would be to reengineer the process. The reengineering approach needs to be fortified by technology to decipher user intent and improve the intelligence within business processes so that they self-adapt to changes using automation and digitization.

Technologies such as AI, analytics, location-based services and mobility are offering new ways to dramatically reengineer and simplify processes. In the motor insurance business, processes are being reengineered for claims validation. An insurance claim can be made using images and videos of the damage captured by a mobile application. These images are automatically geo-tagged and sent over a mobile application to the insurer along with copies of documents such as a driving license. An automated system examines the digital files, assesses the damage, suggests approximate costs and directs the customer to the nearest workshop along with approvals. As soon as the customer accepts the assessment, the workshop is alerted with details of the customer's requirements. Processes like these normally take days and require the intervention of an expert (in this case, a surveyor). Smart processes cut down the time taken and bring in increased efficiency and improved customer experience.

The impact of smart processes on organizations can be profound. Even more compelling is the fact that they can eliminate customer frustration and exhaustion without forfeiting accuracy or outcomes. This is because smart processes understand context, account for it and simplify practices using **essential building blocks:**

Digitalization[3]

- **Reimagination of processes:** Every process is reimagined as a value-driven and experience-led customer journey. Democratization of wealth management, direct-to-customer sales of insurance, social engineering for probable leads, innovation in physical-to-digital in the retail space are a few examples of how process reimagination is helping scale businesses and achieve market penetration.
- **Immersive user experience:** Processes need data. Acquiring data takes time. This part of process management can be automated with simple 'tap to service' type of systems. For instance, when power supply equipment in the field breaks down, a field engineer can troubleshoot the faulty equipment using AR-enabled heads up displays. As the engineer views the piece of equipment through the display, all the data associated with the faulty equipment is gathered and analyzed automatically and guidance is provided to the field engineer to fix the fault in the form of rich media overlaid on the display.

[3] *For more information see page 43*

Intelligent process automation (IPA)[3]

- **Smart workflows:** Smart workflows allow business users to achieve what they have long wished for—meet business needs by adapting and re-configuring processes without IT intervention—and do this in real-time. Smart workflows can be seen in the utilities industry when a provider needs to rapidly change customer-servicing processes due to an unforeseen event, say a snowstorm. The business uses a GUI-based no-code/low-code platform to quickly change the CRM process to suit business exigencies.
- **Robotic process automation (RPA)**: RPA is more groundbreaking than it initially appears. Deploying RPA in life, property, casualty and healthcare insurance can typically result in 100% accuracy and shave off around a third of processing time. It uses invisible lines of code within existing applications to perform repetitive and standardized tasks.
- **Cognitive process automation (CPA):** CPA goes a step beyond RPA by mimicking human thinking and actions. CPA applies ML, data and analytics at a higher level to dig into perceived human emotions and intent. CPA is already being applied in manufacturing, retail, banking and the utilities industries to improve customer satisfaction, sales and loyalty. An example would be the due diligence process for a new client. This can be done automatically in an agile and lean manner by gathering information and reading through documents, understanding the social sentiment, etc., all done by leveraging ML techniques such as natural language processing (NLP), natural language understanding (NLU) and risk modeling.
- **AI-driven decision automation:** AI injects coherence and insights for autonomous decision-making and drives dependable forecasts. This enhancement has the effect of placing sophisticated decision-making into the hands of even non-specialists and neophytes. Anyone associated with wealth management knows that the best advice goes to the big accounts. But advisor bots using AI-infused processes can offer wealth management to classes of customers who otherwise would not have been able to afford the service of a skilled and proficient advisor.

Smart platforms

As applications adopt the smart imperatives, platforms will play a crucial role in providing services that help bring awareness, intelligence and autonomy. These platforms will use common computing infrastructure, cognitive capabilities, event-driven services and autonomous capabilities. This infrastructure will then be provided as a service to every application.

Platforms will serve as the building blocks of smart applications. They will be supplemented by microservices, reactive systems and containers that are currently exploding on the application horizon.

Smart platforms solve previously intractable problems. The utilities industry provides indicators to how these platforms improve 'smartness'. It is important for the utilities industry to take action before service quality drops or outages affect customers. The scale of utility operations makes it difficult to stay proactive. A smart monitoring platform could preempt such outages by acting on signals from customer's IoT-enabled home, office or plant, push the data though an event-processing engine, forecast an outage and surmise the potential cause. This in turn will feed the applications that can trigger several self-defined

[3] *For more information see page 43*

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actions. Applications built on such platforms can proactively assign tickets to service engineers using ML. Such a platform can also use APIs so that external parameters such as weather forecasts, news and seismic activity can be monitored and used to make forecasts.

Smart platforms come in different shapes and sizes. They are often built upon each other to ease the creation of smart applications. Among the **platform categories** are:

Cloud native platforms[4]: These are platforms that provide services for building cloud native applications—compute, network, storage, database, containers, messaging, notifications, APIs, DevOps, security, serverless services, etc. Heroku, OpenShift and Cloud Foundry are good examples of cloud native platforms.

Horizontal platforms[4]: These are platforms that provide technology capabilities like blockchain, IoT, AR/VR and cognitive computing. These are labelled 'horizontal' because they can be used across industry domains. IBM Watson, Salesforce Einstein, and Wipro HOLMES are examples of such platforms.

Digital business platforms[4]: These platforms provide services for enabling digital businesses. They either operate as a business ecosystem by themselves or help businesses create such ecosystems. UberRUSH, the ride-hailing company's express delivery service, gives an insight into how smart platforms work for digital businesses. UberRUSH can be used in standalone mode or its APIs can be used to integrate it with a retailer's digital products.

Smart security

Applications don't sit in isolation any longer. They are not confined to a datacenter or a system. Today, they are everywhere—buzzing inside mobiles, wearables, self-driven cars and drones. They are connected 24x7 to a vast and dynamic ecosystem of sensors, devices, databases, analytical engines, networks and third party plug-and-play systems that help draw out insights for the enterprise. As banks, retailers, consumer goods manufacturers, utilities and governments adopt new ways of doing business and interacting with customers, they are also being forced to deal with more amorphous IT architecture. In effect, the digital surface of applications has grown several-fold and has even become fuzzy in places, making them more vulnerable to attacks.

Adaptive security architecture, or smart security, responds to the risk from dynamic environments. It also focuses on ensuring users are not inconvenienced by authentication and validation processes even while maintaining extreme security. For example, in the case of a bank

[4] *For more information see page 51*

account, user security can be based on variables such as transaction value, user behavior, user location, network and device/IP. Depending on the level of risk, the variables indicate authentication processes can be raised to include secure passcodes, fingerprints or biometrics. Adaptive security architecture allows users to access applications with the least inconvenience while securing data at a whole new level.

Smart security architecture is the bedrock for systems to monitor today's dynamic threat scenarios. The architecture establishes a continuous AI-driven feedback loop of intelligence-gathering, analytics and risk-based decision making. Smart security, with adaptive and secure authentication and authorization mechanisms, is a business enabler. It contributes to securing data and interactions while enhancing user experience. There are a **number of approaches that can be used to make security bulletproof:**

Adaptive authentication: This is multi-factor and multi-modal authentication adaptable to all digital surfaces powered by business-driven algorithms.

Context aware entitlements: These are dynamic entitlements-based policies derived from user context, transactional context, environmental context and ML.

Reduction of threat amplification: The concept of proactive monitoring and surveillance to surface threat intelligence is combined with a smart response system to create improved security.

Adaptive security architecture: A dynamic environment calls for dynamic risk modeling and security controls.

Cognitive cyber assurance: It is not enough to have controls and assets in place that raise an organization's security posture. The bigger question is, "Do these controls and assets work?" In other words, in a dynamic environment the controls for defense may become inadequate and require continuous modification, calling for an entirely new security game plan.

Cognitive cyber defense: This is a logical next step to cognitive cyber assurance and is meant to deliver in-line and real-time monitoring, detection, analytics, remediation and resolution of threats.

Automated and orchestrated response: This calls for a case management platform and collaboration between teams responsible for threat management and can automate incident response processes.

DevSecOps: It is imperative that security is integrated into the DevOps cycle and made part of an application's DNA from the moment its architecture is defined.

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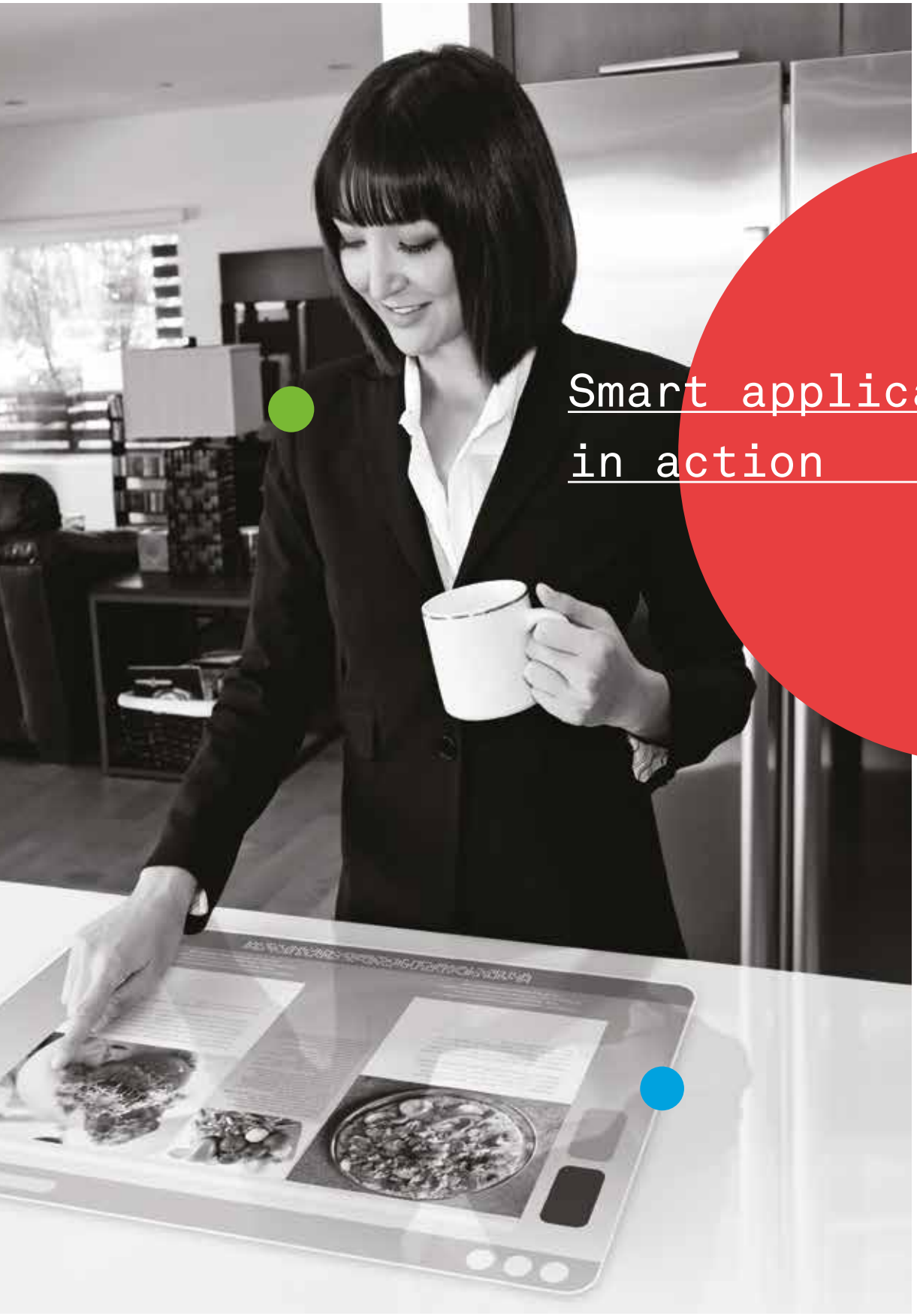

Smart applications in action

Industries across the board are going through disruption driven by technology. This is blurring the boundaries among industries. Banks are increasingly behaving like retailers, retailers want to emulate hi-tech companies and new industry verticals, such as aggregators, which did not exist a few years ago, are thriving. Smart applications enable industries to redefine their business models and strategies in this dynamic environment.

The banking industry has become a beacon for smart application development. Through innovative use of advanced technologies such as blockchain, AI and NLP, smart applications are creating the next generation of banking. It is leading the way with a strong thrust in areas of digital banking. Especially notable is its use of automation for customer onboarding and RPA for Know Your Customer (KYC) processes. Automation has introduced a minor revolution in the industry's effort to meet stringent regulatory requirements.

The retail industry is at an interesting inflection point. It is currently witnessing a major battle between the old and the new. Digital retail is rewriting the rules of customer engagement with hyper-personalization. It is among the foremost industry segments using smart applications to shed its traditional ways and evolve. No industry can afford to take its eyes off retail where innovation bubbles up with unerring regularity.

The largest shift in practices is being heralded by the utilities industry. Here, smart applications are revolutionizing field operations, optimizing supply chains and putting control into the hands of customers over their energy usage. The utilities industry is vigorously taking on the excruciating challenge of integrating its legacy investments with smart applications and, from available evidence, is making healthy progress.

These three industries provide us with instances of a wide range of smart applications in action, many of which can be adopted in practically any industry.

2.1 Smart banking

Banking is embracing digital with gusto. The rapid change this has brought about is evident in how banking renders services, responds to customers and enables employees. The change in the industry provides us an indication of the role digital plays in banking innovation, particularly in retail banking.

Digital in banking has given birth to a new breed of players. There are more than 50 digital banks that did not exist until two years ago. WeBank, digibank, Atom, Soon, Monzo, Orange and Pepper are signs that an industry can create stiff competition overnight. These banks use technology to acquire and service customers; they offer familiar products like traditional banks, but they don't necessarily have physical branches; and most importantly, these banks are oriented around customers and not markets. Their aim is to deliver experience and value that matter to customers.

Long-standing players aren't too far behind. They are busy exploring technologies such as blockchain to smarten processes like trade finance (that are littered with intensive paperwork and record keeping) and are using technology for clearing and settlements (processes that require expensive manual reconciliations). The smartness brought in by blockchain make them practically unrecognizable from the banks we have known them to be for decades.

When examined closely, it is evident that the banks are creating transaction capabilities and advisories that make them a part of their customer's everyday life. Banks have begun to service their customers for needs as diverse as education and travel to making life's celebratory moments like marriages and promotions more memorable.

Banks are modernizing with a clear focus: to become the center of their customer's life. This has led to noteworthy innovation. Turkey's DenizBank developed an augmented agricultural banking application to deliver real-time knowledge, alerts and live expertise on crop rotation, planting, watering and purchase of farm equipment[iii]. These services and capabilities are far beyond the remit of a traditional bank. Much of this has been achieved through non-traditional alliances and collaboration inside and outside the industry. There is single-mindedness in the application—to make the bank central to the life of customers from the agricultural sector.

Like DenizBank, other banks are developing applications that bring intelligence to every customer touchpoint—these touchpoints span tellers, ATMs, mobile applications, chatbots, social media and partner channels. The applications bring together CRM strategies, predictive analytics, personalization engines, ML and NLP with intuitive and frictionless interfaces. The objective is to make customer interactions personal, simple and consistent across channels.

Leveraging technology-backed innovation, banks are exploring previously unimaginable business possibilities. These include supplementing loans for customers through crowdfunding or collaborating with partners to transfer funds across borders.

The memo on banking is loud and clear: infuse intelligence into applications, hyper-personalize, provide real-time services, deliver value to customers, save time, go multilingual and be available 24x7x365 at every touchpoint.

A new era in banking is here. It is pushing banks into interesting new business territories. It is moving straight into the hearts of millennials who have been weaned on digital. And, most importantly, banks are becoming an intrinsic part of the everyday lives of their customers.

The memo on banking is loud and clear: infuse intelligence into applications, hyper-personalize, provide real-time services, deliver value to customers, save time, go multilingual and be available 24x7x365 at every touchpoint.

Smart banking in action

All the 4 imperatives of smart applications come into play in the transformation journey to smart banks.

Let's see the example of Alex, a 33-year-old marketing executive working at a digital marketing company. Alex wants to buy his first home. Buying a home is a fairly tedious and complicated task. Alex has to sort and grade scores of property options, balancing them with what he can afford. After shortlisting properties, he will have to look for the best mortgage options. Mortgage options are typically not transparent and are accompanied by reams of fine print and paperwork. This makes it difficult to take a decision on mortgage with confidence (see Figure 5).

Figure 5: Home-buying process

The process is not easy for banks either. A minor lapse in interaction can lead to poor customer experience. An error in judgement can cost the bank financially and in terms of reputation. But this need not be the case. The journey, from providing Alex with home options to approval of mortgages, can be reimagined using smart applications (see Figure 6).

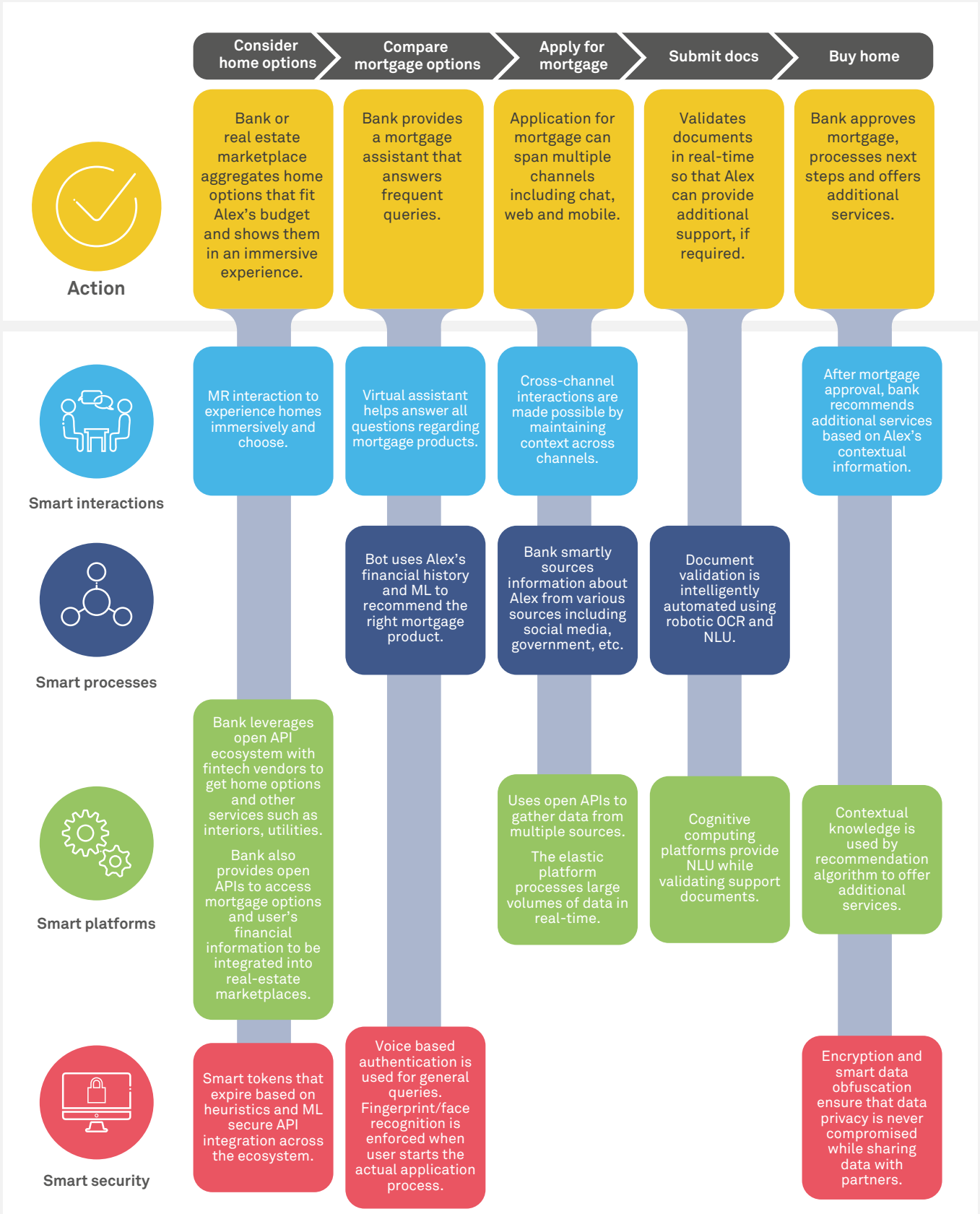

Figure 6: Home-buying process reimagined with smart applications

Smart applications deliver Alex an integrated experience of home buying by bringing banks, brokers and other partners together. He can educate himself about the process, products and mortgage options, and ask any question to the virtual assistant at his own pace. Intelligent automation and digitalization make the entire process shorter and efficient, making Alex's buying decision, insights-driven and faster.

While the reimagined journey provides a great experience to the user, banks also benefit. They are able to reach users far beyond their channels of control, such as embedding their services transparently into real estate marketplaces. By doing so, banks are stepping further left (from origination) into home buying processes, offering services such as advisory and research. Banks can also significantly improve their ability to be efficient, thereby providing better experience on parameters such as:

- **Improve conversion ratio:** Smart interactions combined with smart processes and smart platforms will help streamline the experience and process from front to back and be contextual throughout, thereby reducing dropouts.
- **Reduce average closing time of mortgage approval:** Smart processes can bring in significant automation, while smart platforms will bring in real-time integration across the ecosystem including third parties, by which current industry average closing time of 35 days can be significantly cut down.
- **Workforce experience and productivity:** By bringing in contextual intelligence and other smart interactions, bank employees' ability to serve their customers more efficiently is enhanced, leading to better worker productivity.

The key themes that transform banking to smart banking are:

- Conversational banking
- Intelligent onboarding
- Bank as-a-platform
- Smart authentication

Conversational banking

Conversational banking has the advantage of being able to sustain a dialogue between the user and the bank to achieve the user's goals. Much of conversational banking currently offered by chatbots is rudimentary. The bots answer simple questions. What they need to do is grasp user needs and intent. To progress to the next level they need to adopt elements that go into the making of smart applications:

Multi-channel strategy provides users with conversational applications that are independent of the channel, but adapt to different channels such as mobile, web, voice and text. Strong NLP, NLU and generation capabilities, speech-to-text and text-to-speech are required to back conversations across channels.

Contextual interfaces build situational, environmental and financial context of a user in order to provide accurate service and advice. Context makes the conversation brief and delightful, keeping unnecessary and irksome questions out of the way.

Multi-modal interaction combines chat with other forms of input like keypad, voice, touch or gesture, which switch based on context. Whether a user is checking balance or filling a form, having access to multiple forms of inputs makes the interaction friction-free.

API integration allows conversational applications to work in concert with a bank's core systems and provide a full spectrum of services.

Intelligent onboarding

A challenge in onboarding customers is the volume of communication required due to a bank's siloed operations. Frequent changes in regulatory requirements add to front office challenges. This means complex products can take months to activate, triggering customer dissatisfaction. CPA can eliminate these hurdles by automating phone calls, emails and the validation of multiple documents:

Multi-disciplinary cognitive bots specializing in finance, legal, accounts, risk and compliance can interact with customers along with the relationship manager to accelerate onboarding processes.

360° smart visualization of workflows can provide real-time alerts for risk profiling, assessment of non-performing assets, credit worthiness, etc., of the business entity (bank's customer).

Cognitive process automation can aid in analyzing news items/social streams/annual reports to instantly show anomalies in business entities (see Figure 7).

Figure 7: Intelligent onboarding

Bank as-a-platform

Opening a bank's assets as a set of APIs drives collaboration and innovation to provide unparalleled services to customers. Standardized APIs are also the base to launch new distribution channels, comply with regulatory norms such as PSD2 (the revised Payment Service Directive) and create differentiated services by co-innovating with the new breed of fintech companies.

Banks like Citi, TD Bank and Capital One are leading the way by offering bank platform services as open APIs. Silicon Valley Bank has partnered with Stripe to provide banking facilities as part of the onboarding process to entrepreneurs. To get started, here are the key enablers:

Open APIs allow existing systems to be consumed by fintech companies, third party developers, value chain partners and other industry verticals to build new services for customers such as extending loans to home hunters.

Platform strategy provides standardized services at an infrastructure and platform level to onboard partner applications. The platform strategy can be around a private cloud model or public cloud providers. Additional services to generate insights can be built using existing customer datasets. Cognitive capabilities, blockchain, AR/VR can be leveraged across data to deliver not only rich customer experience, but also provide a 'platform' for delivering services beyond banking through the ecosystem.

Blockchain plays an important role for bank as a platform. It brings transparency to a bank's platforms, reduces operational costs and significantly improves several of the bank's internal operations related to fraud, risk management, payments, etc.

Smart authentication

With banks addressing consumer needs though APIs, mobile applications, chatbots, social channels and third-party applications, the challenge is to verify customers before they can access services. Customer authentication should be strong to assure security, but not so complex that it disrupts user experience. The balance can be achieved using:

Biometric authentication that leverages the uniqueness of fingerprint, facial recognition, vein pattern and the retina integrated with smart phones and wearables to make the banking experience smoother and more secure.

Adaptive authentication that uses contextual parameters like transaction value, user device and ambient factors to dynamically evaluate risks and adjust the authentication process making it more (or less) rigorous.

Recommendations

Smart applications are opening new avenues in banking. Banks must reimagine the customer experience, delivering services wherever the customer is, even when the customer is not actively interacting with the bank. The focus of smart application innovation should be around making the act of banking invisible and traditional processes redundant (just as the mobile industry made rotary phones disappear), without compromising security. Rather than build these capabilities from scratch, banks would do well to open their platforms to innovators and partners while simultaneously developing in-house expertise on technologies like AI, CPA, blockchain and AR/VR. It has often been said that today's banks are technology companies with a banking license[iv]. This is a realistic observation that is likely to be accentuated over a period of time.

The focus of smart application innovation should be around making the act of banking invisible and traditional processes redundant, without compromising security.

2.2 Smart retail

There are several reasons for retail being a frontrunner for smart applications. First, consumer technologies have heightened our expectations from retailers. We want more personalization, we want more engaging experiences and we want faster, error-free service. Second, the retail industry has a stockpile of information about its customers, their demographics, buying patterns, brand preferences, and payment methods to arrive at personalization, pricing and promotional decisions.

We see some of the most practical deployments of smart applications in the retail industry. This is despite the fact that the industry is often perceived as being risk-averse and mired in traditional processes.

Machine vision, complex algorithms, NLP, data and analytics are powering entirely new ways to improve customer experience, engagement and process efficiency. McDonalds, the fast food chain, is using cognitive technology to enhance the drive-through experience at its outlets. Speech algorithms are used for specific ambient noise at the drive-through to improve speech quality and capture the orders. The orders are transcribed automatically using speech-to-text technology and conveyed to the kitchen[v]. Everyone gains from the new processes that create speed, accuracy, efficiency and convenience.

For far too long, retail processes, such as order to cash (O2C) and procure to pay (P2P), have been through incremental change. Now, they are moving beyond optimization to a stage of complete transformation. This is because retail is putting 'smart' into everything, from experience to engagement and efficiency (see Figure 8).

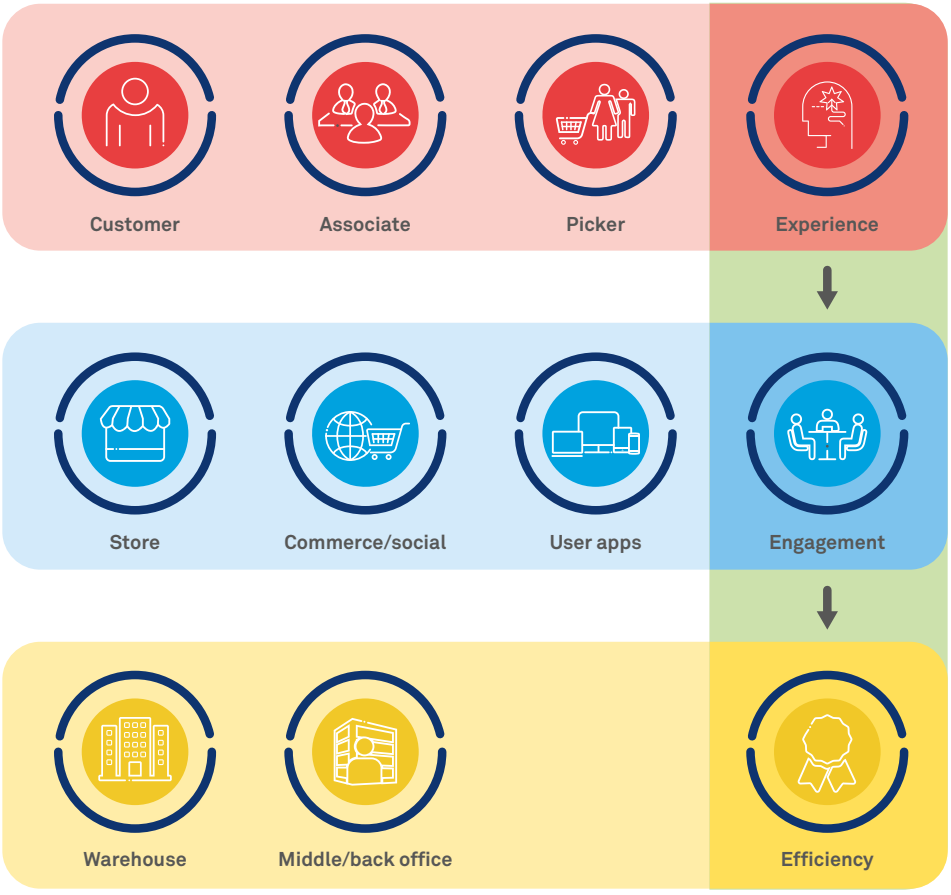

Figure 8: Retail customer experience goes 'smart'

Smart retail in action

Let us examine how the 4 imperatives of smart applications—smart interactions, security, processes and platforms—alter the shopping journey of Rachel who loves to shop and doesn't shy from using technology (see Figures 9 and 10).

Figure 9: Smart shopping experience at home

Figure 10: Smart shopping experience at store

Rachel's experience at home and in the store, can be mapped to the 4 smart imperatives.

Smart interactions

Smart interactions are created at home using conversational commerce and virtual assistants; in the store, they are created using AR, magic table, and store associate applications.

Smart processes

While at home smart processes help her with API mashups, reminders, recommendation and convenience services, while in the store they help the workforce with task prioritization, comprehensive 360° customer views, next best action (NBA), product metadata enrichment, product provenance, and track and trace via blockchain.

Smart platforms

Smart platforms enhance the retail experience at home and in the store through context management and microservices.

Smart security

Smart security is leveraged in the store through advanced authentication methods.

Smart applications provide Rachel with a very engaging and delightful shopping experience across physical and digital channels. Shopping becomes more convenient, highly personal and she is assisted with relevant advice across her shopping experience. From a retailer's point of view, they are able to:

- **Increase customer footfall**: Incentivize customers to visit stores/digital channels more frequently
- **Increase shopping basket size:** By right substitution, upsell and cross-sell based on product affinity identified by metadata of products
- **Make operations more efficient**: Checkouts are optimized by reducing manual intervention

The key themes that transform the retail industry are:

- Conversational commerce
- Store associate enablement
- Smart retail platform
- Hyper-personalized retail

Conversational commerce

Retailers don't need highly trained associates or back office staff to answer simple customer queries. These queries can be offloaded to conversational bots. Typically, bots can handle queries like the status of an order (where is my order?), drive quick action (please put my weekly grocery list on hold) and help make purchase decisions (if you have low-fat protein bars, add a dozen in the cart). The hands-free nature of smart devices like Amazon Echo and Google Home and their anytime/anywhere use makes conversational commerce ideal for interactions. In a store environment, one of the hidden advantages of bots over store assistants is often not emphasized adequately. The digital nature of the interaction means that the retailer can capture more customer data—which is otherwise lost, diluted or poorly interpreted by store assistants. Figure 11 shows the technologies, platforms and processes that go into conversational commerce:

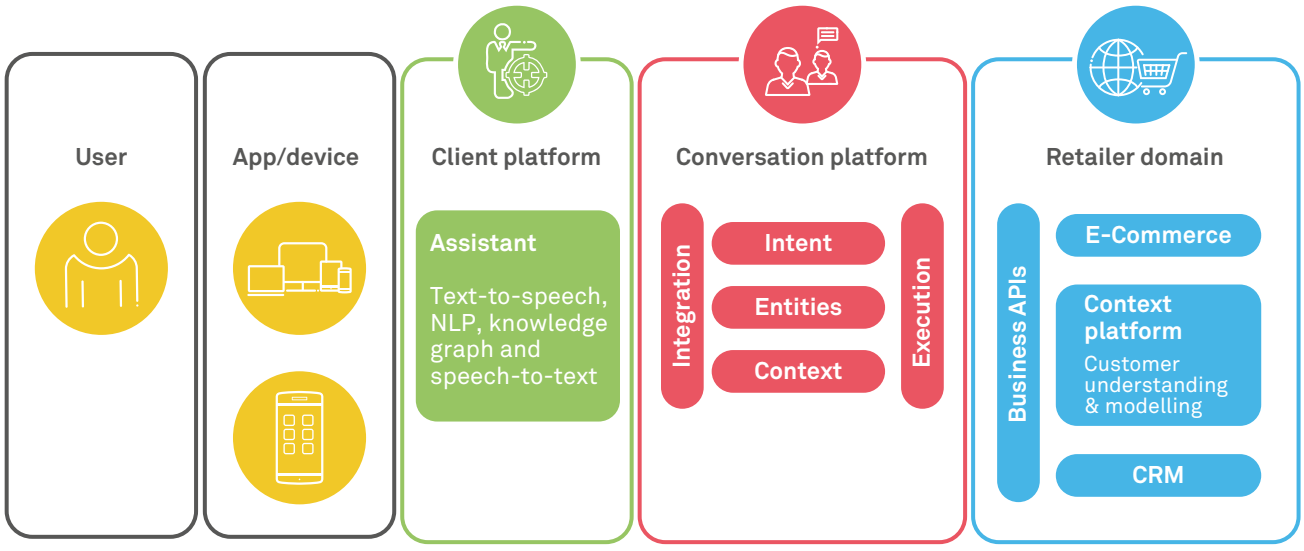

Figure 11: Conversational commerce: technologies, platforms and processes

Apps/devices are the endpoints consumers interact with. They have the necessary logic to receive consumer inputs in the form of speech or text.

Client platforms use NLP or speech-to-text that allow inputs to be understood by machines.

Conversation platforms build the conversation by analyzing past conversations, context and current intent.

Business APIs execute the intended action on the retailer's system. This includes responses to questions like, "where is my order?" and to requests like, "please put my weekly grocery list on hold."

Context platform digs into recent and adjacent customer requests/actions to progress the shopping with recommendations on NBA and next best conversation (NBC).

Store associate enablement

Store associates are important. They deliver and improve the customer's in-shop experience; they are responsible for POS terminals, customer service and support; and they also manage replenishment, price changes and pick and fill orders. A store associate's skills are highly valuable at customer touchpoints within the store. A retailer therefore aims to minimize the mundane and manual tasks handled by associates and maximize their availability at human touchpoints. Smart applications can assist in achieving these goals with:

Task assignment and prioritization based on an associate's location, time of the day, and events such as proximal inventory movement. The knowledge of an associate's expertise is used as the criteria to assign tasks automatically (such as selecting an associate to handle food allergen queries). The solution needs a strong event driven architecture, geo location of associates, a configurable rules engine and continuous prioritization algorithms to optimally assign tasks.

Customer 360° view and NBA for store associates includes insights on customer preferences, past purchases, purchase patterns and sentiment analysis based on recent support calls. The system also provides visual cues on NBA (such as suggesting accessories for the customer). This view is enabled by a customer context platform and the capture and analysis of past actions of the customer along with a NBA analysis engine on top of browsing history across the shop floor, mobile and internet channels.

Search assist that provides product data such as size, color and availability in inventory to the associate when approached by a customer to find the right product. The solution improves the associate's performance with:

- **A global inventory view of products.** This view covers the store, other stores in the chain as well as warehouses. An associate can initiate an order from any of the locations to service the customer.
- **Smart supply chain visibility** takes customer service a step further when a product is not available in the existing inventory. The product can be ordered directly from the supplier or the manufacturer via smart supply chain visibility.
- **Image-based search** allows a store associate to use a smart phone or a tablet to scan a product and then let image recognition show the closest results for matching products from the store or an online catalog.

Associate learning can be made interesting via gamification, AR and chatbots. These are experiential tools that make it easier for associates to understand and remember store/warehouse layouts, SOPs and product information.

Smart retail platform

Historically, retail businesses have used commercial off-the-shelf products without a coherent platform strategy. Some have built custom monolithic applications which have now become legacy. These platforms cannot scale or adapt fast enough to business change. On the other hand, smart retail platforms borrow technologies used by internet scale companies. These introduce elasticity and agility into retail. The base of smart retail platforms includes:

Elastic scaling for seasonal and unexpected loads leveraging cloud native architecture and microservices architecture. Appropriately changing or customizing few microservices also allows a single retail platform to be deployed across multiple geographies.

Real-time behaviour makes sense of and reacts to business events in real-time, which is useful in situations for understanding the demand for products and taking necessary actions.

APIs and micro apps on top of traditional platforms quickly enable new retail experiences and channels of business.

Machine learning uses data to mimic humans and generate an element of surprise for consumers with delightful data-based insights.

Hyper-personalized retail

Smart retail's traits such as personalization, NBA, etc., require a deeper understanding of the customer than traditional CRM systems can deliver. This higher order of understanding is the result of context awareness platforms that are built on:

Consumer modelling using elements such as customer purchase history, browsing, linger time, location, family members, time, season of shopping etc. The model is enriched with each event and becomes increasingly reliable.

Product data enrichment helps understand products better, just like the way consumer modelling gives insights on consumer preferences. It helps in improving the quality of search. When product metadata such as nutrition, flavors, fat content, origin, etc., for groceries are extracted, products will appear in searches more often. Product metadata is highly underutilized, perhaps because the data is visible only to the trained eye. However, scale can be achieved using automated data extraction techniques, ML and social listening.

Targeted recommendations are the next step after product features have been extracted. They are made by combining the results of consumer modeling and product data enrichment. For example, a strawberry-flavored, low-fat protein bar can be offered as upsell or substitution if the regular product a health-conscious customer buys, say a blueberry bar with whey protein, is out of stock.

Recommendations

The retail industry has the advantage of owning enormous amounts of rich customer data. Consolidating it and accessing additional data in real-time should be the next steps. Data makes conversational commerce possible, data makes store associates more effective, and data makes customer context a powerful personalization and experience tool. Now add AI, ML and cognitive technologies to the mix and retail can develop revolutionary capabilities such as visual product search and contextual marketing that makes it easier for customers to reach decisions.

The retail industry has enormous amounts of rich customer data. Now add AI, ML and cognitive technologies to the mix and retail can develop revolutionary capabilities such as visual product search and contextual marketing that makes it easier for customers to reach decisions.

2.3 Smart utilities

Utilities is an industry in the throes of transition. It is grappling with rising costs, aging infrastructure, dramatic changes in products (renewables) and business models with pressure from customers to provide user-friendly digital experiences.

A reasonable part of our earnings go to utilities. Households in the UK, for example, spent 4.4% of their annual incomes on energy (2015)[vi]. Lower income households end up spending almost 10% of their income on energy[vii]. This is extremely high. When energy spend is 6% of total income it is considered unaffordable. Clearly, there is an urgent need to drive down energy costs and consumption. Consumers have begun to demand a more 'social' and 'retail' type experience from their utility providers so that they can control costs and consumption.

Can a utility provide smart applications to communities that enable collective bargaining for energy pricing? Even more importantly, can utilities gamify applications that change and reshape customer behavior to reduce consumption? Can utilities leverage smart metering to reduce distribution losses and reduce waste?

There is a parallel revolution brewing on the energy generation front in the form of distributed generation. Consumers are feeding their excess power (from solar and wind) into the grid—and with improved local storage options, they want to sell when the buyer's price meets their expectations. The dynamics of production, distribution, availability and pricing are in flux, forcing utilities to rethink their decades-old business models.

Utilities want to predict breakdowns, reduce downtime, optimize procurement contracts by forecasting demand, provide smooth customer experiences and leverage behind-the-meter ecosystems with new age consumers.

These imperatives are driving a huge transformation in the industry. Utilities were always the 'behind the scenes' players. Now, they need to step up their game and take on a more 'social' face, interact with new prosumers and drive loyalty and retention.

To meet these changes in how products and services are designed, developed, implemented and delivered is not simple. It calls for applications that are adaptive, intelligent and context-aware. These applications must help customers understand their needs, predict demand and manage costs. They must allow customers to freely switch their products (for example, they can switch from thermal to solar power). And the most urgent need is to provide customers access to their own consumption information so that they can make more informed choices. Finally, customers are keen to use behind-the-meter installations that assist in bringing down the carbon footprint and allow them to buy energy at the lowest possible price.

In other words, the utilities industry needs smart applications to address their own needs and those of their customers.

Can a utility provide smart applications to communities that enable collective bargaining for energy pricing? Even more importantly, can utilities gamify applications that change and reshape customer behavior to reduce consumption?

Smart utilities in action

Let's examine Bryan's interaction with his utility provider to pay his bill and raise a complaint (see Figure 12). Bryan is swamped with work and has missed paying his bill. He is on his way home from office. He is looking forward to a ball game at home and has invited his friends to come over.

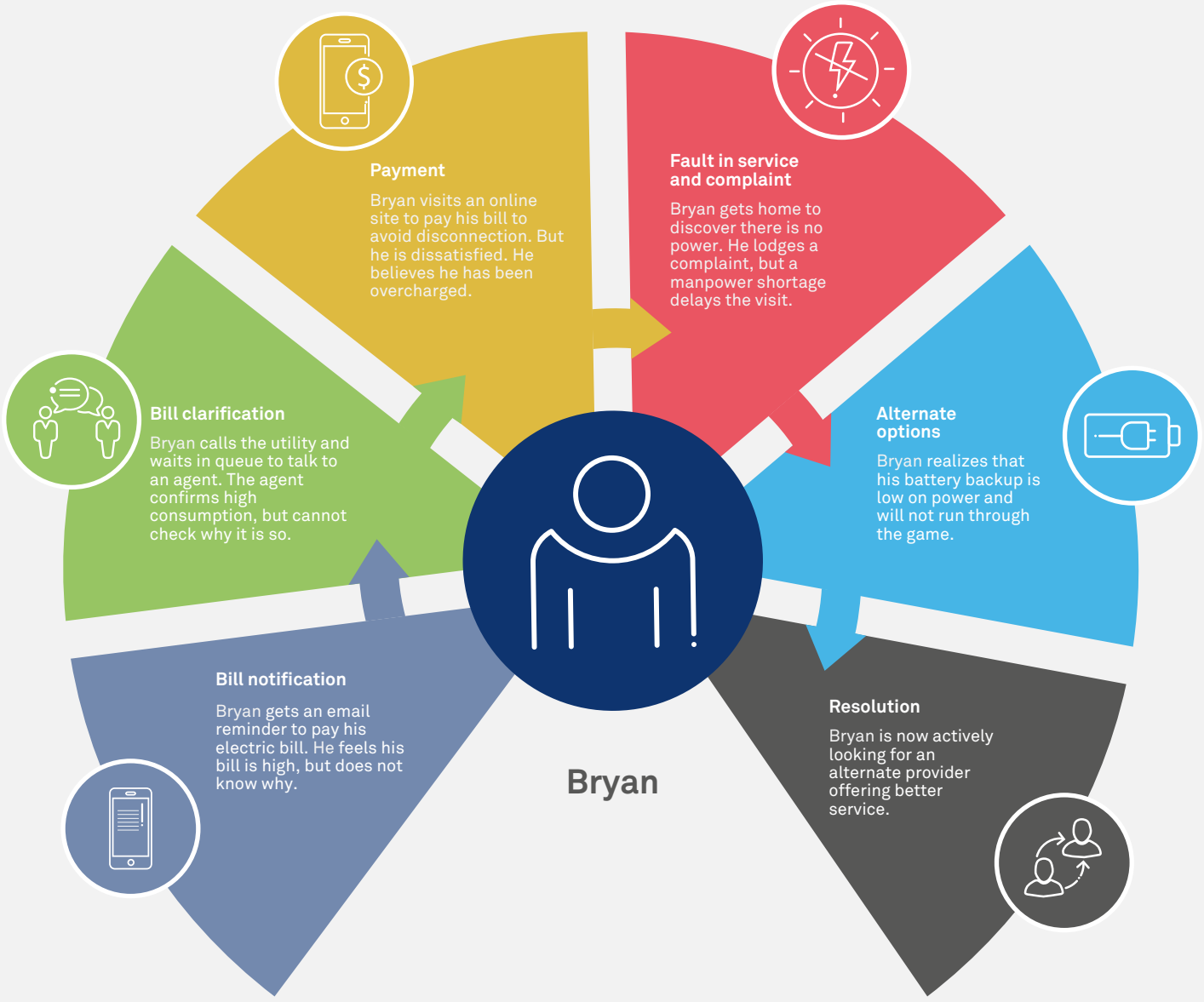

Figure 12: Bryan's interaction with energy provider

Bryan's interaction with his utility went south because of a lack of information. Next, there was a service disruption that made him miss the game with friends. To make matters worse, Bryan had no way of knowing that his backup was low on power. The utility was not equipped to respond immediately on what was a standard query on incorrect billing. The utility also did not have visibility into its manpower problems, so it could not adequately warn the customer about resolution times. Smart applications could have intervened at each step of the interaction with Bryan, preventing unwanted outcomes. (see Figure 13).

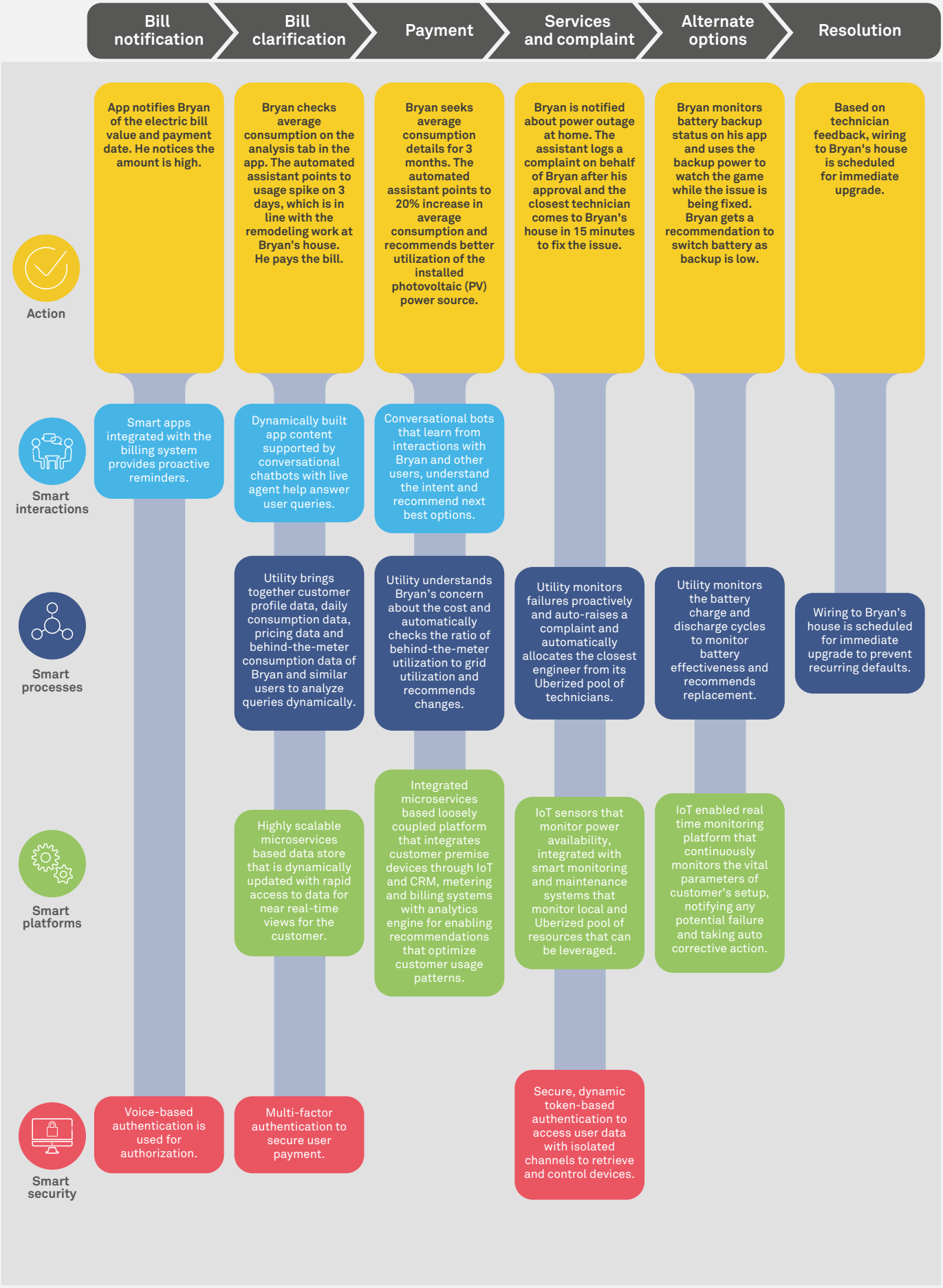

Figure 13: Bryan's interaction with a smart utility provider

Figure 13 shows that Bryan is kept engaged at every stage, as the utility resolves his query through suggestions and options. This is done by providing Bryan with information and analysis around his billing over an application. He receives suggestions on how to optimize his consumption and manage requirements using a mix of local and grid sources. The high point for Bryan is when his situation is monitored and a complaint raised proactively. The issue is fixed by tapping into an external pool of skills rather than waiting for service personnel on the rolls of the utility to be available. Bryan gets an alert regarding the status of his backup with recommendations for better backup and preventive steps are taken to avert future failures.

On the whole the utility is now more responsive. Bryan feels he is in control rather than being dependent on the service provider. At the bottom of this is the muscle of smart applications.

Some of the key themes that transform the utilities industry are:

- Personal utility assistant
- Smart field operations
- Digitization of utilities ecosystem

Personal utility assistant

Customer information systems (CIS) used by utilities cover basic billing and support. These fall woefully short of today's expectations for instant information, prompt reaction to problems and strong engagement from the provider.

Personal utility assistants address some of these shortcomings. They provide ways for the user to access their data, analyze it, pay bills, raise issues and track them until they are resolved. These assistants are loaded with smart features that include:

Consumption bill payment and payment history that covers consumption—the consumption is segmented by the hour and with related costs. Using a smart platform, customers can change consumption—for example, increase consumption at off-peak hours that draw lower charges.

Utilization trends which provide insights by comparing consumption within various groups and fine-tune the result based on factors like home size, number of occupants, location and weather. Customers can be provided recommendations and feedback based on common patterns drawn from a larger set of users.

Predictions and recommendations that proactively recognize equipment malfunction through IoT networks and recommend solutions based on observable trends (like the charge-discharge cycle of storage cells).

Transfer of connections across localities enabled by an application that validates the movement through smart processes and uses adaptive smart security for authorization.

Conversational interfaces for advanced customer service that replaces clunky click-to-retrieve processes. The rudimentary conversational interfaces of today are rapidly becoming more sophisticated at deciphering interactions and answering broader questions.

Smart field operations

The biggest challenge for utilities continues to be the shortage of maintenance manpower. The difficult nature and size of terrain over which infrastructure is spread and the complex nature of equipment makes it impossible for small teams to resolve issues fast enough. A few key innovations in the area of support are increasing efficiency and optimizing costs:

Uberization of field support is helping just-in-time sourcing of local field workers through reimagined processes. This eliminates the need for large field teams to address mainly low risk issues. Uberization also cuts down response times and keeps the skilled teams focused on core infrastructure maintenance. The

solution requires the design of a smart system to match skill requirements and identify available workers. It then distributes maintenance requests based on training and capability. Workers pick up requests that interest them.

AR and VR experiments are already being aimed at providing assistance to field engineers to track and locate assets and equipment in remote locations, identify components, assemble and disassemble those using assistive AR/VR technologies. There are two key components of such smart interactions: the ability to seamlessly integrate with the worker's equipment (example: eyewear/headset) and the network bandwidth to stream data.

Collaboration through conversational interfaces reduces resolution times for field issues. A field engineer can outline a problem or a symptom using pictures or video to collaborate with remote experts and create fixes. Bots help conversational assistants inject smartness into interactions. They do this by integrating with a variety of systems, pulling up maintenance histories, leveraging NLP and using self-learning loops to provide field engineers with accurate guidance (and do other jobs like raising orders or alerts).

IoT to detect failures by connecting devices to smart IoT platforms and identifying anomalies based on performance patterns. This prioritizes maintenance based on predicted time to failure and criticality.

Drones that assist with maintenance make it easy to inspect assets (such as gas pipes and transmission lines) spread across hundreds of miles. Drones are endpoint devices that can inspect these assets, detect anomalies, analyze them or upload their feeds to real-time cloud-based analytics engines. Smart analytics platforms seamlessly integrated with various systems can process information from a swarm of drones to prioritize and order maintenance schedules.

Digitization of utilities ecosystem

Distributed resources provide utilities with new ways to manage demand and procure energy. Smart applications that integrate behind-the-meter sources and consolidate them at the utility will provide invaluable insights on customer consumption patterns and available local backup to manage surge demand. Smart applications will also provide customers with the means to optimize energy consumption though analysis of charges, rates and their consumption patterns.

Such applications can provide:

Integrated visibility to all sources of energy like PV panels, battery, and grid, agnostic of the underlying make or model of equipment.

Fine grained control for the user to decide which source of energy to use along with recommendations on the best source to use at any given time.

Dynamic optimization of battery charging/discharging cycles to maximize self-consumption and optimize demand.

Immediate visibility on current and planned demand for the utility to optimize production and procurement.

While smart applications provide benefits, consumer devices that are part of the new utility ecosystem can heighten threats as they are more vulnerable to attacks. Pre-approved and largely restricted access along with dynamic key-based encryption of information and multi-factor authentication will comprise the elements of smart security. These can then be used to control state changes by users.

Recommendations

Transformation in the near future for the utility industry will be incremental, driven by customer demand. Among the first areas that will benefit are those related to customer convenience and field operations. These two areas stand to gain from the use of smart applications. However, utilities have just begun to experiment with the technologies and platforms that enable smart applications. Adoption has been slow and measured because such initiatives need to be integrated with legacy infrastructure, which can be cumbersome and could present security risks. However, there is nothing to prevent utilities from introducing smart applications in low risk areas—such as leveraging AR/VR for training—and add momentum to their smart applications journey.

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Realizing the 4 smart imperatives

Organizations attempting to realize smart applications may quickly find themselves mired in a complex web of alternatives, forcing frequent strategy reviews and eroding budgets. While there may be no absolutely perfect roadmap, there is a structured process that results in a more effective way. Here, we provide guidance to realizing the smart imperatives. Following them eliminates the frustration of uncertainty and the prospect of failure:

Capability building across people, processes and technologies provide the first foundational ability to realizing the smart imperatives. Identify gaps across these areas and then plan to build the desired capabilities.

Prioritize the areas where you can showcase the power of smart applications. The approach need not be completely disruptive. Instead, adopt a brick-by-brick approach that produces the expected outcomes while ensuring that the new applications can co-exist with the old.

Tie into business outcomes instead of driving the initiative in isolation. For example, while re-engineering an order management process, include elements of smart interactions by adding a chatbot that can place orders or update status instantly.

Progressively modernize applications
Modernization is an integral part of successful smart application realization. This activity itself can leverage smart imperatives using elements such as CPA for data migration.

Look at the imperatives together instead of in isolation. The imperatives inherently have dependencies on each other (smart interactions play a major role in smart processes to deliver better worker experience; smart security leverages smart processes to automate security operations, and so on).

Exploring the imperatives in detail and understanding their constitution and the industry ecosystem provides us with useful guidance in the journey to smart applications.

3.1 Smart interactions

If you were among those who saw the first iPhones in 2007, you'll recollect the awe it inspired. You could touch the icons and simply slide a button. It felt so natural. It felt magical. It is not often that we experience such awe in the way we interface with applications.

Click, drag and drop and keyboards were invented decades ago. Unfortunately, they continue to be the primary mode of interaction with applications. With digital becoming the norm, customer experience is evolving. Digital native organizations are turning experience into a 'science'. The science is creating smart interactions, re-defining the way businesses connect with consumers.

Humanizing application interactions

What we understand with immutable confidence is how humans interact with other humans. If we could humanize our applications by introducing elements of context, emotion, intent and even human biases, our interactions will become conversational and natural. The challenge is to make applications smart enough to mimic human patterns of behavior.

The healthcare industry provides many examples of how smart interactions can provide interesting

Digital native organizations are turning experience into a 'science'. The science is creating smart interactions, re-defining the way businesses connect with consumers.

(probably lifesaving) experiences. Humanizing interactions with technology will help doctors drive better patient outcomes. With privacy controls in place, conversational applications can have instant access to patient health records, and medical knowledge databases to provide contextual and relevant answers to patients' questions. Virtual assistants will help doctors manage patients better by providing access to patient information, appointment details and so on. MR can be used to train surgeons on newer procedures, in visualizing patient's diagnostic imaging, and to treat a variety of phobias that patients might have.

Humanizing application interactions depend on elements of smart interactions built and delivered through conversational applications, multi-modal interfaces, MR applications and contextual interfaces.

Conversational applications

Improvements in NLP, Natural Language Generation (NLG) and speech-to-text technology are making conversational applications possible. Conversations with applications are on the increase. Google has reported that 20% of web searches on Android devices are now voice based[viii].

Standalone chatbots, a type of conversational applications, have their limitations and cannot handle a full range of humanized conversations. Integrating them with rich data makes them highly effective in conducting near-human conversations. We find chatbots hosted on platforms like Facebook, Slack and Skype. While the platform concerns itself with bot discovery, curation and identity management, the chatbots implement human behavior.

Virtual assistants such as Google Assistant, Amazon's Alexa or Microsoft's Cortana are the second type of conversational applications. While they possess conversational capabilities just like chatbots, these are more human-like, can have a broad range of skills, and are extensible. Custom skills and business-specific capabilities can be developed and added to these assistants. Conversational bot platforms like Avaamo and Dialogflow (earlier called Api.ai) are playing a key role in integrating these two types of conversational applications. Using such platforms, chatbots can be integrated into virtual assistants.

These platforms also help integration with APIs and data from enterprise systems, making conversational applications more useful in the context of a business. These platforms provide capabilities such as NLU, user intent detection, and also the ability to converse with users across web, mobile, chat and voice assistants.

Multi-modal interfaces

Offering multiple modes of input simultaneously makes it easy for users to interact naturally with applications. The added benefit is of letting users choose a way to interact. For example, chatbots can present a form-based interface to capture fine-grained data or multiple data elements, when required.

Multi-modal interfaces are very effective in enhancing the effectiveness of conversational chatbots. Text-based conversations can often be limiting, especially in accurately capturing user inputs such as numbers or when showing responses that include long form text, visuals, etc. But a multi-modal interface can overcome the limitations by using graphical elements such as cards, carousels, forms and other traditional input and output elements to enrich the interaction. For example, chatbots can use cards along with text inputs. The cards show action buttons based on the context of the conversation. The user simply picks the most appropriate button to move the conversation along. Another example of a multi-modal interface is the use of gestures while interacting within immersive experiences delivered by MR applications. Since users are immersed in interacting with physical or virtual worlds within these applications, alternative input mechanisms that involve voice, gestures and other sensory inputs enhance the experience.

Mixed reality applications

One of the barriers to MR applications has been the cost and accessibility of hardware. The recent release of Google's ARCore and Apple's ARKit is changing that. AR is reaching smartphones and AR-based applications are set to disrupt the application interaction space. ARCore and ARKit use standard smartphone hardware such as the camera, accelerometer and gyroscope. Readings from these sensors are enriched with algorithms for real world position tracking. Along similar lines, Microsoft's MR platform is lowering the barrier to the VR ecosystem. It uses inside-out tracking, making VR headsets lighter and eliminates the need for extensive calibration, making setup easier.

With MR becoming accessible, industries such as retail, manufacturing and utilities, where immersive experiences play a significant role, will lead with adoption.

Manufacturing is one of the verticals where MR promises new opportunities to modernize manufacturing environments. Modern manufacturing requires assembly of thousands of components, and AR can help by guiding workers with instructions in their field of view. Maintenance of complex machines is another area where AR can prove to be extremely powerful. AR can visually detect component errors and provide instructions for fixes, thus improving accuracy and productivity.

Utilities, telcos and healthcare are other verticals where MR applications will begin to emerge for processes such as remote product repair, remote facilities management, medical diagnosis and surgeries.

Delivering smart interactions through MR is dependent on how virtual and physical worlds are made to interact intelligently. Here, AI methods for real-time image recognition and object identification will play a key role (example: Google's Vision API can be used to detect objects and text in a video frame; this information can be used to provide additional contextual information and augment the videos in real-time). While most AR frameworks have capabilities to detect real-world objects and aspects, it is AI that brings domain-specific intelligence to power smart interactions.

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Contextual interfaces

Contextual interfaces work by deciphering multiple input signals from users and other sources in order to build context and understand the user, thereby contextualizing the interface. The key methods that go into crafting contextual interfaces include:

Dynamic content generation and page layout creation based on the user's previous history, search terms, social feed, etc. This information dynamically adapts content and keeps it relevant to the user. Product similarity, user similarity and other prediction algorithms are used to arrive at the best content and layout. This type of contextualization is very relevant in consumer-

facing mobile and web applications such as an e-commerce portal. A good example of this is a dynamically generated product catalog or a product page layout based on the user's interests.

Push notifications that proactively deliver information designed to drive the user to perform specific actions. This can be applied to applications across domains, especially to nudge time-sensitive actions. An example of an intelligent push notification would be providing an alert for a meeting based on a calendar event and adjusting the alert considering the distance between the user's current location and that of the meeting plus calculating the time taken to reach there.

Customizing the interaction flow is a sophisticated example of how contextual interfaces can prove to be effective. Conversations work best when they are crisp and to the point, so it helps to keep user inputs to the minimum. By sensing context, user inputs can be derived and then applied to create the right flow of interaction thereby reducing the friction between the user and the application. An example would be to assume a user's payee details based on past transactions in a smart banking payments scenario.

Delivering contextual interfaces requires real-time event processing capabilities, access and integration into various enterprise and social data sources, ML for predictive capabilities and finally an action or information delivery mechanism to create the appropriate interface.

Approach to building smart interactions

Smart interactions are about bringing new experience technologies to applications. But that is not where it ends. There are challenges related to building know-how, understanding what works and what doesn't, and designing interactions from a user's perspective. Some of the key challenges we foresee are:

- **Difficulty in finding the right use cases**. This is always a challenge—both, in terms of usefulness as perceived by end users as well as the ROI as expected by the business.
- **The need for experimentation**. Smart interactions require a significant use of NLP and other ML based algorithms. These are very different from imperative programming that enterprise development teams are used to. Developing smart interactions will probably call for more experimentation (and more patience).
- **Frustrating rework**. Technology is evolving very rapidly. What was relevant yesterday may not be relevant today. There may be better technology options—and this could result in considerable rework (failing which there could be quality issues to address).
- **Need for design from an end-user perspective**. Designing smart interactions requires significant thinking from an end-user perspective. Application development often fails to dwell on and account for the user's needs, behavior and convenience.

The smart interactions capability framework (see Figure 14) suggests the different dimensions to be considered to address the challenges for building smart interactions.

- **Interaction design:** Building capabilities in smart interaction design using new types of interfaces is key. Understanding how these interfaces work will help design better interactions with customers and employees. Design thinking, which empathizes with users, will come into play in order to build better interactions.
- **New models:** New models of working augment the new interaction models. The use of ML requires experimentation and a fail-fast approach so that the interactions evolve faster, leaving the best to survive.

- **Cloud native:** Given smart interactions involve responding to user events, serverless applications and containers play an important role in building them. Micro-services architectures and PaaS platforms are an important capability to deliver them faster and evolve the experience continuously.
- **User context:** Data platforms must be leveraged to develop user context and infuse interactions with intelligence.
- **Platforms:** In order to scale the applications to enterprise level, smart interactions require the following platform support:
  - Cognitive computing, AI/ML and NLP capabilities
  - Security for new access points
  - Specific capabilities to manage conversational interactions and immersive behavior
- **Integration:** Headless/API based business interfaces are essential to smart interactions. Creating the necessary APIs on top of existing applications will help smart interactions integrate with enterprise systems.

Figure 14: Capabilities for building smart interactions

Smart interactions ecosystem

The smart interactions ecosystem is evolving with innovation from large and small open source and commercial vendors. See Figure 15 for some of the key players in conversational applications, MR applications and contextual application development space along with the required enablers. Please note that this figure is indicative and should not be construed to be complete.

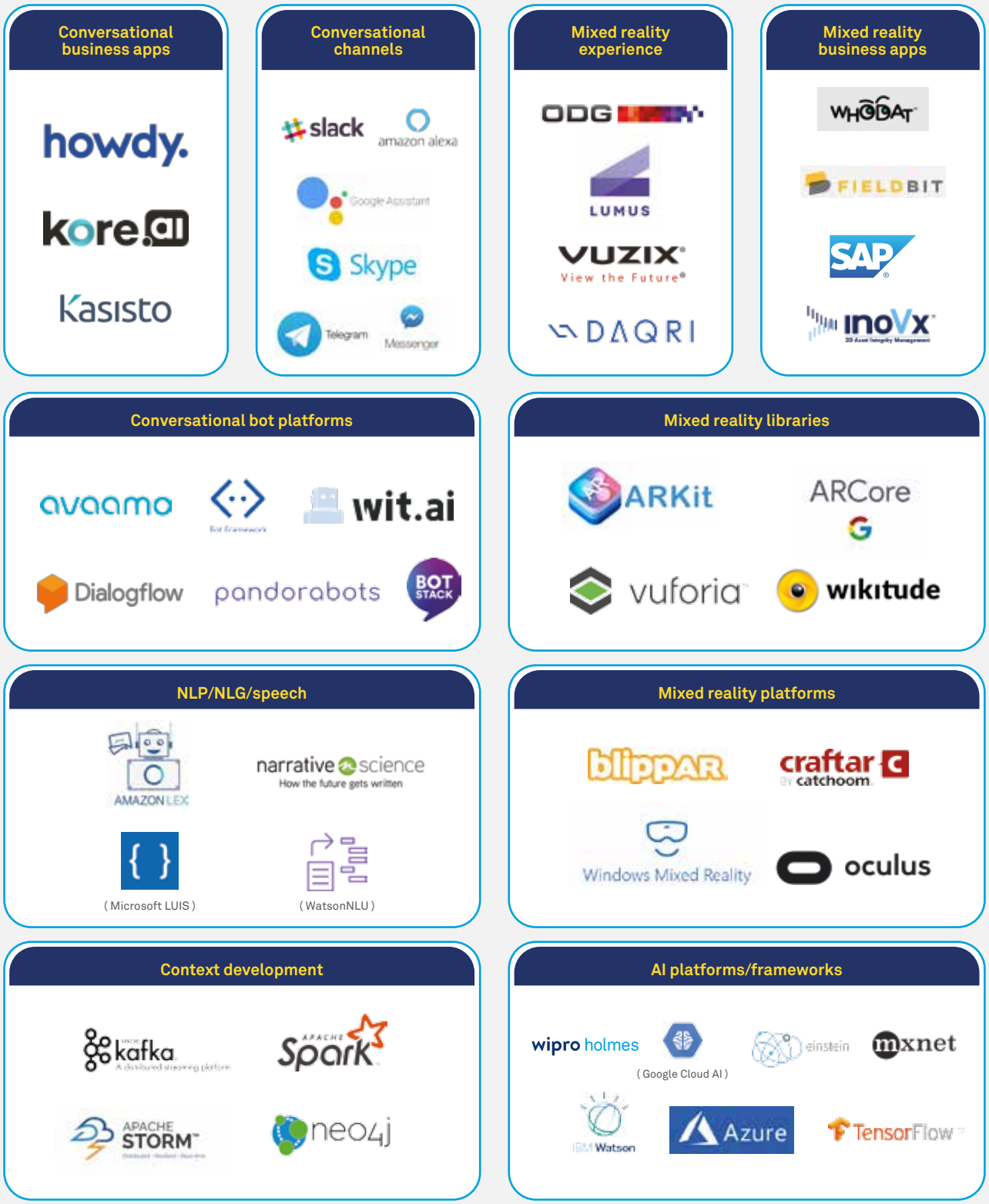

Figure 15: Smart interactions ecosystem

3.2 Smart processes

Process efficiency, process modeling and process management have been the name of the game—at least until now. It will be IPA and stakeholder value creation that will be vital to future ready businesses. Smart processes learn from every run of the process, they adapt to situations and context, they proactively listen to events, automate by infusing intelligence and eliminate mundane activity to deliver higher productivity.

For example, construction equipment manufacturers can employ smart processes using IoT to track parameters for health monitoring of equipment, service alerts, equipment usage and geo-fencing. Equipment monitoring for usage helps deliver equipment through a disruptive usage-based costing model (equipment as-a-service) instead of customers having to procure the equipment. Geo-fencing ensures the equipment does not move outside the set boundaries. As another example, telecom companies are implementing smart processes for site surveys, supply chain and project management in network deployment projects. Smart processes help complete work in a single site visit and help with dynamic execution of tasks. The field service is well prepared to easily alter activities depending on external factors such as problematic terrain, regulations, etc. Smart processes enable supply chain management at a global scale with a unified monitoring dashboard.

Smart processes are enabled by digitalization and IPA (see Figure 16).

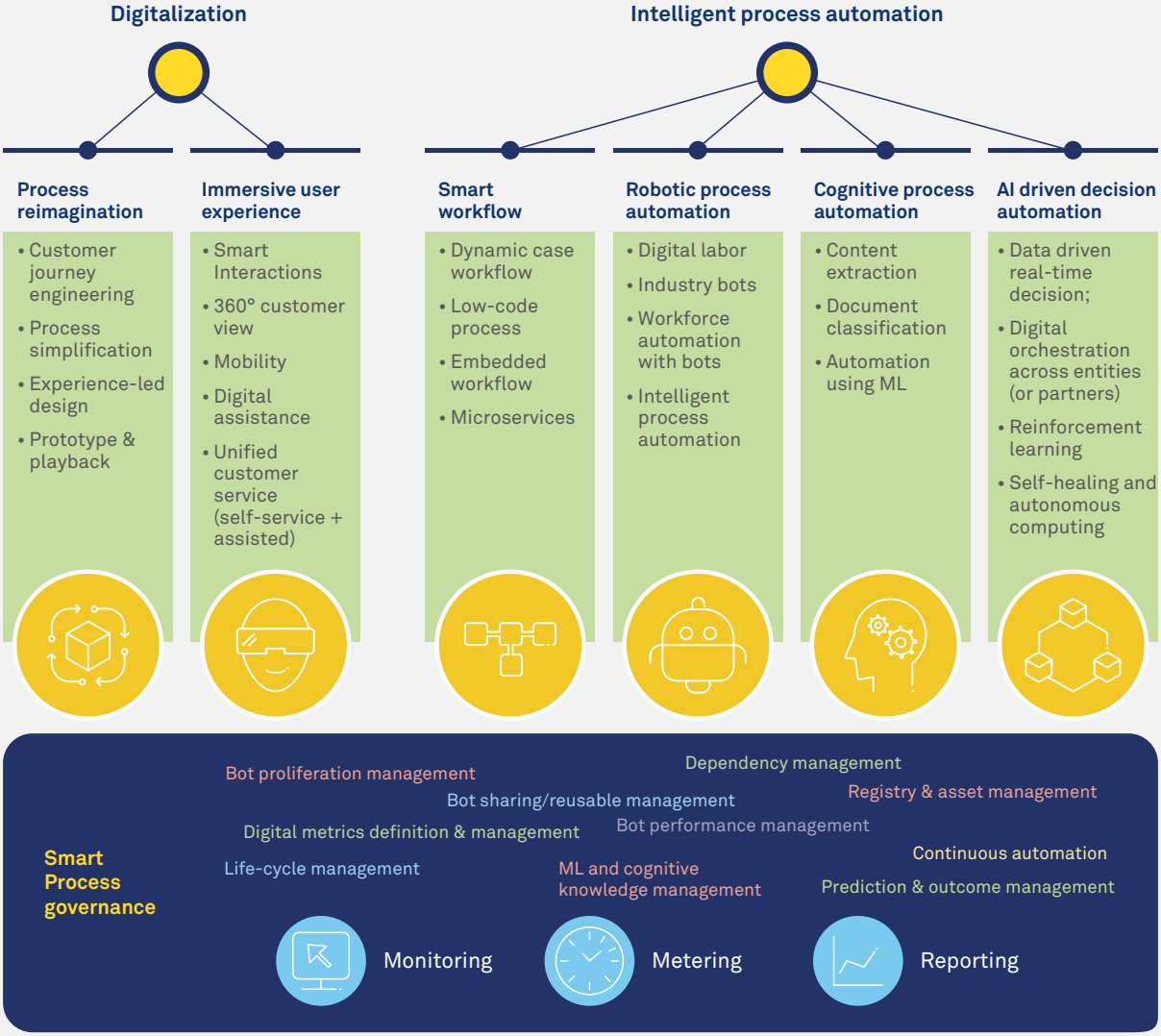

Fig 16: Smart processes

Digitalization

Process reimagination This allows the introduction of disruptive business models that help penetrate new markets, reach new customers, enhance the value to customers and scale the business beyond traditional boundaries. Business process reimagination and the 'lift and shift' of activities through design thinking digitally engages customers. This happens transparently across channels when insights are leveraged. It empowers users in a never-before manner. Business can also scale without increasing workforce, sales agents and advisors.

Immersive user experiences are made possible through smart interactions by leveraging mobility, omni-channel, and intuitive and responsive interfaces. Facial recognition, digital signatures, co-browsing, voice-to-text, MR, API and IoT are the technology enablers for smarter interactions (human-machine or machine-machine). By understanding the context of interactions and identifying exactly what the user needs—be it a customer looking for a particular product or the head of operations migrating operational risk—users are made more productive. They are able to gain better value from businesses processes.

Intelligent process automation

Smart workflows (flexible, resilient process and empowered business users) eliminate the need for IT interventions when new workflows are required. With rapid changes in business models and processes, it is inadvisable to hardwire processes. Organizations now prefer real-time wiring, unstructured process and dynamic routing. To do this, business need more control to change the process flow in run-time.

This is achieved through IPA components that comprise of low-code configurable workflow engines and drag-and-drop adapters/connectors to application systems. Dynamic case management, microservices and APIs are the tools that help in executing these unstructured processes and integrations.

Robotic process automation (automation of rote operational tasks) tools deliver work automation and introduce digital labor through configuration and reduced coding. They eliminate rote activities and bring higher productivity to operations. Operations that require time and effort on manual data entry tasks and manual data validations across multiple systems can now use RPA to reduce errors, for customer escalations, data integrity issues and penalty payments.

Cognitive process automation (nimble, high speed business operation) equips the operation team with tools for cognitive document search, smart visualization of data and predictive dashboards to quickly execute tasks which need complex assessment of data. Peak burst of operational workload namely month-end reconciliations, quarter-end transaction closure, etc., put too much pressure on operations and result in schedule slippage and poor customer experience. But CPA can manage spikes in workloads. This major strength of CPA can be used to replace manual time-consuming processes such as risk assessments, credit worthiness checks, scanning company board member details and negative news across multiple systems. Document reading, due-diligence and other manual intensive tasks with unstructured content are automated using NLP and smart optical character recognition (OCR).

AI driven decision automation (bring autonomy, self-healing to processes) enables the organization with capabilities for coherent business decisions at the right time. This is designed and implemented using ML, B2B digital orchestration, IoT and insight-driven decision engines. Outcomes are measured and fed back to the system that continuously adapts using the new inputs (such as changes in business policies or rules) through ML. Business orchestration and decisions that are highly manual, time-consuming and complex—such as after-market warranty management, anomaly detection in industrial quality assurance (QA), dynamic pricing, supply chain inventory orchestration,

customer service chatbots and collaborative care in healthcare—are designed to bring more accuracy, economic value and customer satisfaction.

Approach to building smart processes

Enterprises should aim to adopt digital technologies and data insight platforms to enrich their business process with intelligence, make them context aware and ensure they bring value. A three-to-eight month timeframe can be considered reasonable to remove rote activities and demonstrate short term gains on cost through digital labor. The strategic transformation play, in a two-to-five year timeframe, should consider re-imagining the customer journey for experience and value. This is achievable through:

- **Strategy, platform, tools and governance:** To start with, an organization's digital strategy should clearly define its goals and objectives. Every process should be examined from the perspective of the user's journey and through the lens of the various touchpoints. Strategic and design thinking workshops should be organized to define operating models, tools, governance, architecture platforms and a smart process roadmap. The governance model should address bot proliferation, performance, lifecycle management and dependencies.
- **Detailed process mining, opportunity refinement and planning:** Reimagining and re-engineering processes through design thinking workshops will also trigger cultural changes within the organization. Smart process opportunities need to be refined, prioritized and executed in an agile manner without changing the existing way of working.
- **Smart process implementation:** A 'Learn and Adapt' model of implementation must be followed to automate, bring intellige measure value (through monitoring and metering) and finally, refine the decision models.
- **Platform customization:** Bring the best-of-breed capabilities to a smart platform by stitching together capabilities of individual COTS products or open source stack. For example, if a particular business process management (BPM) platform does not have cognitive capabilities, it could be integrated with an external product which has cognitive capabilities.

The following key technical capabilities (see Figure 17) are necessary to enable smart processes:

- **Service anywhere**: Chatbots/digital assistance, co-browsing, facial recognition, biometric, AR/VR that enable 'service anywhere' in smart process.
- **Flexible digitalized processes**: Smart platform capabilities like dynamic workflow routing, unstructured process definition and routing that help in flexible digitalized process.
- **Contextual insights**: Automated data and content collection/aggregation, semantic data extractions, transactional insights and smart search solutions that bring real-time contextual insights to operations.
- **Customer relevancy**: Content insights with advanced visualization, NBAs and linking customer journeys that bring conversational customer relevancy.
- **Machine learning**: System concepts, models and algorithms and associated tools for curve fittings, regularization and visualizations help in and in implementing cognitive capabilities.

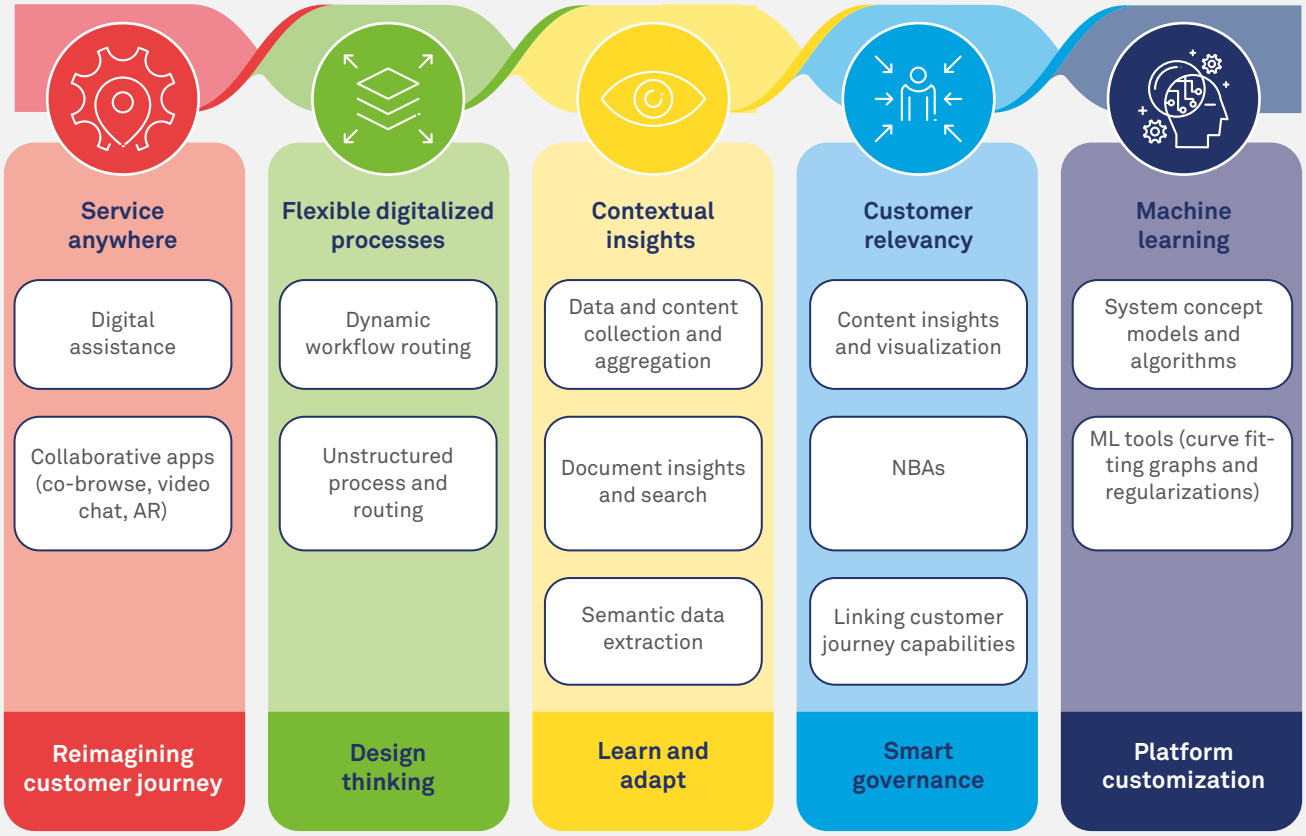

Figure 17: Capabilities for building smart processes

There are several pitfalls that enterprises need to avoid when delivering smart processes through digitalization and intelligent process automation. The checklist includes:

- **Absence of digital value metrics in automation strategy:** Each process or customer journey will have objectives to be met and intended business value to be delivered to stakeholders. The automation strategy should define, monitor and assess the digital value metrics for all important processes.
- **Assuming shorter automation timeframes**: Cognitive or AI modules need to continuously learn and adapt through digitalization and automation. The thresholds defined for decisions need to be learned and evaluated, cost curves should be generated to check overfitting and underfitting. There should be clear separation of concerns during project executions and certain decisions cannot be fully automated on the first drop, but must be closely monitored in production so that the model can be fine-tuned with feedback. Hence, the strategy should define a slow step to automation.
- **Ignoring operational empowerment:** The journey of the operations team is very important. Attention must be given to every transaction to ensure the team is empowered and highly productive.
- **No governance as bots proliferate:** As an increasing amount of automation is adopted, the number of bots will also grow, resulting in operations losing complete control. It is important therefore to govern bots with the right monitoring and metering tools.
- **Absence of intelligent oversight and accountability:** Assigning accountability to automated tasks ensures that intelligence is better managed. A responsible, accountable, consulted and informed (RACI) matrix can be used to structure responsibility around each task.

Smart processes ecosystem

Smart processes are no longer about processing structured data models, connecting systems and executing rules. They are more contextual and intelligent. Traditional BPM, enterprise content management (ECM) and mobile platforms are enriched with contextual intelligence and cognitive capabilities through the integration of AI and analytics platforms.

A number of COTS vendors are embedding cognitive capabilities into their solutions. A wider choice of COTS and open source products is available to stitch together (or embedded within) and create a unified smart process platform. This unified platform will have the following digital platform capabilities:

- Unified digital channel and mobile infrastructure
- Dynamic case management
- AI-infused BPM
- Cognitive decision engine
- Insight-driven ECM
- Domain-specific data and insights platform (analytics/AI)
- Customer applications system integrations and API platforms

Solution elements and capabilities are configured and implemented on the platforms. Platform capabilities are enhanced by integrating products and solutions from multiple vendors (see Figure 18), thereby filling the gaps associated with a particular product.

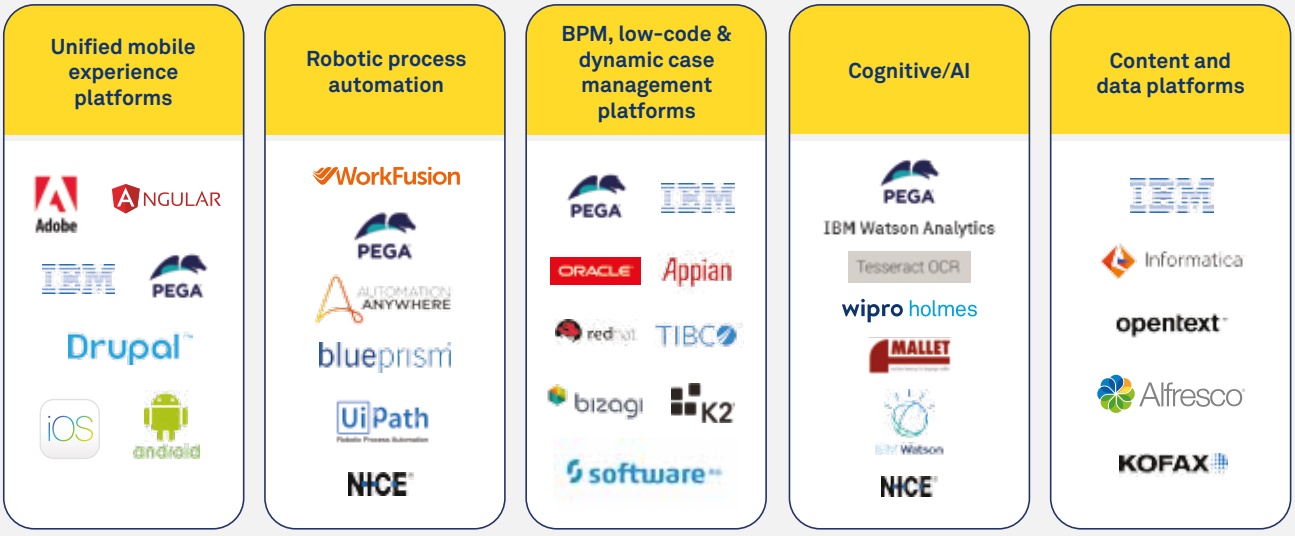

Figure 18: Smart processes ecosystem

3.3 Smart platforms

The success of the iPhone can be attributed as much to its pathbreaking hardware and design as to the app platform (iOS App Store) that breathes life into it. The platform's digital services are driving iPhone adoption. One of the key forces behind the success of tech companies such as Amazon, Google, Facebook and Alibaba are the smart platforms they built for their innovative products and services. Companies like Uber, Airbnb and Shopify use smart platforms to power their digital products, leading to disruptive strategies and differentiated business models. APIs from Stripe, SendGrid and Twilio make their platform capabilities easily consumable and extendable by developers to build valuable experiences.

While the services offered by the platforms is the primary measure of a platform's utility, the key to successful platforms are capabilities such as the ability to evolve features continuously, ease of extensibility, and autonomous behavior to manage the complexity of platform operations. These capabilities define smart platforms. All the three categories of smart platforms—digital business platforms, horizontal platforms and cloud native platforms—will have to exhibit these capabilities.

The platform economy is here and it is changing the way industries function. Digital businesses that adopt a platform strategy and bind into the larger ecosystem of partners will stand to benefit by protecting their core business and improving their path to profitability.

Smart platforms empower businesses

Smart platforms are one of the building blocks of smart applications. Importantly, they also amplify business outcomes. Their impact is across strategy, partnerships and business models. Here are some of the ways smart platforms can empower businesses.

Business models: Platforms are driving newer business models. Organizations can create their own platforms or plug into partner platforms to roll out new products and digital services. The platform becomes a springboard to integrating the value chain. GE uses Predix, the industrial IoT platform, to build applications around its products and new business models. Another example is Shopify that provides ecommerce as a service across countries using its platform.

One of the key forces behind the success of tech companies such as Amazon, Google, Facebook and Alibaba are the smart platforms they built for their innovative products and services.

Accelerated transformation: Platforms provide a foundation over which to build and integrate applications. Once the foundation is in place it becomes simpler to leverage APIs as the platforms handle the more challenging aspects of data, scale and resiliency beneath the APIs. The end result is faster application development, integration and evolution. BNY Mellon, using its NEXEN℠ platform, delivers new applications when they are needed and wherever they are needed.

As a service: Smart platforms enable business to leverage their core differentiated processes and data and provide them to consumers as a service. This allows rapid innovation around core products and helps build additional data services on top. A simple example of this is BBVA Bank that has opened its systems and provides API based access via an API marketplace.

Strategic advantage: Platform owners have the power to provide the maximum value within and across the supply chain. As an increasing number of users access the platform and transactions grow, the network effect of the platform kicks in. This can be used to build strategic advantage. Salesforce's Force.com

platform allowed others to add functionality to the core CRM product. This created a virtuous cycle where new functionality, integrations and plug-ins attracted new users, who in turn enriched the platform with more features and functionality. The growing number of users allows Salesforce to provide greater value and lower prices by leveraging economies of scale.

Open up core enterprise systems: Any business-driven transformation needs to leverage existing enterprise assets, such as legacy applications and core systems. Platforms enable this by using service-based architecture to unbundle functional capabilities and data from the existing assets and offer them as services by the wider platform ecosystem. While such unbundling happens, platforms provide a standardized set of Open APIs with a homogenous and stable interface used to build newer capability. Saxo Bank has demonstrated how this is done. Partners and external developers can access Saxo's trading infrastructure to customize their trading experience, multiply trade volumes and launch new revenue streams.

Approach to building smart platforms

As enterprises begin building smart applications they will also need to develop an understanding of the capabilities that go into smart platforms (see Figure 19).

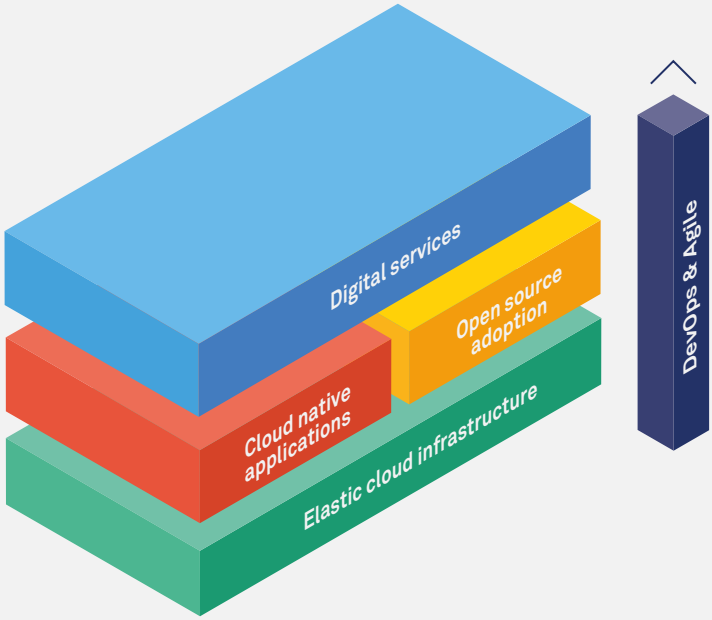

Figure 19: Capabilities for building smart platforms

Elastic cloud infrastructure

Apart from the core functional logic, applications depend on a host of capabilities to become intelligent and autonomous. These capabilities go into the foundation on which smart applications are built. Smart platforms leverage cloud to build resilient, scalable and autonomous applications. Cloud environments provide the ability to program application infrastructure as if it is code. The big three public cloud providers—Amazon Web Services (AWS), Google Cloud Platform (GCP), Azure—offer the key infrastructure services to build smart applications by handling the harder aspects of data, scale and resiliency so that applications can be built quickly. Companies like Netflix have built their entire business around AWS, using cloud to rapidly develop and deploy applications.

Cloud native architecture

Smart applications need to be built as cloud native applications that take advantage of the rich platform services offered by cloud providers. Smart platforms enable leveraging cloud computing, cognitive computing, data-based intelligence and event-driven architectures to make this happen—and by doing so, they can infuse intelligence into applications and make their operations autonomous. Deep and real-time metric profiling, event correlations, along with a robust knowledge base bring automation to application operations and make them autonomous over time. Platforms provide core service capabilities over stable and open APIs, which are then leveraged by applications. When Capital One moved its applications to cloud, they were not doing lift and shift, but refactoring the applications to take advantage of the cloud platform services.

Open source adoption

Some of the most interesting innovations are happening in open source. There is wide adoption helped along by developer support. Smart platforms will have to take advantage of freely available open source support and the innovation ecosystem around it. Increasingly we see platform companies realize these advantages, and open source their proprietary software or build their platforms on open source software.

For example, Kubernetes, which defines building blocks and provides a range of mechanisms for automating deployment, maintenance and scaling of applications, was open sourced by Google for adoption as well as for support from developers. Such strategy from Google is successful as companies like Red Hat, Oracle and Microsoft are building their products and services on Kubernetes.

DevOps & agile

Adoption of DevOps and agile methodology is a key requirement for rapid innovation. By focusing on collaboration and communication between groups, an organization can work more effectively towards a common goal. DevOps promotes process automation to streamline the delivery process via test automation, continuous integration and continuous delivery.

Digital services

What distinguishes one platform from another are the digital services they provide. GE Predix is not just an IoT platform, it integrates with the existing GE industrial products and allows users to build specialized services and models on top of the products. This is where a business can provide maximum value to customers and to value chain partners.

Smart platforms ecosystem

The platforms ecosystem is rich with innovation. Figure 20 provides a representative view of the key players across categories.

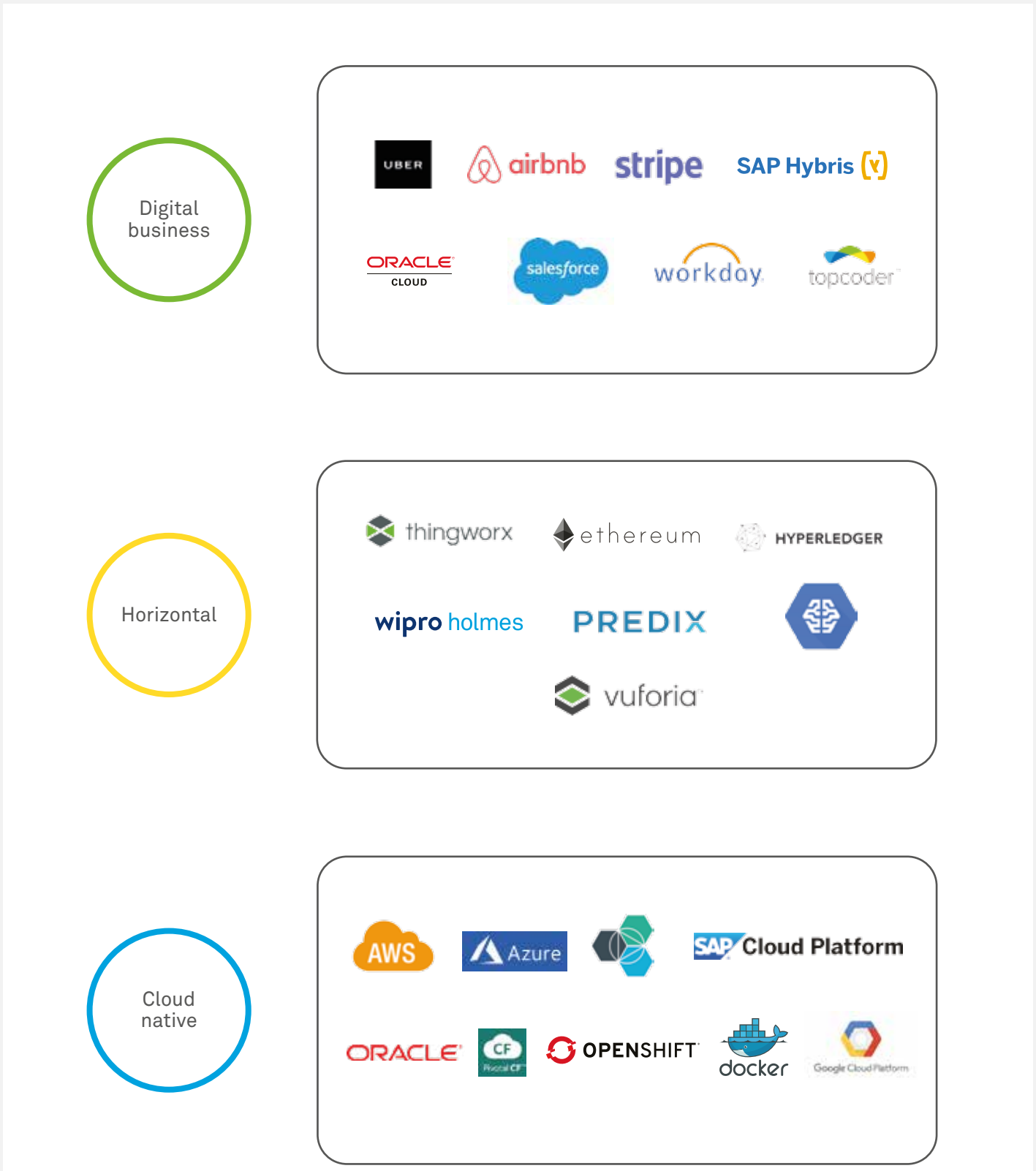

Figure 20: Smart platforms ecosystem

Digital business platforms

Technology providers like SAP and Oracle have made their ERP portfolio available on cloud with Oracle Cloud Apps, SAP Apps, SAP Hybris, etc. These platforms extend and build new digital business capabilities and connect them with the ecosystem through APIs. On the other hand, there are new generation aggregator businesses like Uber and Airbnb that have spawned off new digital services that can be integrated with digital products or consumed on a standalone basis.

Horizontal platforms

There are vendors that have built specific technology platforms and provide those as digital services for consumption such as GE's IoT platform around Predix. Similarly, Face++ has built a platform around cognitive services for facial recognition.

Cloud native platforms

Most IaaS and PaaS vendors fall within this space. Vendors might provide serverless architecture features (like AWS Lambda, Google Cloud Functions) to abstract the infrastructure and application server deployment. Platforms like force.com allow application development using online editors and abstract entire data, application and hosting services.

3.4 Smart security

The proliferation of digital surfaces combined with enterprises embracing new business models have led to a completely new set of security challenges. Enterprise IT security and risk management functions have not been designed to manage the kind of variety, volume and dynamicity being experienced. The complexity and variety of dynamic digital surfaces, networks, operating systems and cloud services (SaaS, IaaS and PaaS) have brought complicated use cases with them. There has never been a greater need for smart security than in the current 24x7 technology landscape.

The complexity and variety of dynamic digital surfaces, networks, operating systems and cloud services have brought complicated use cases with them. There has never been a greater need for smart security than in the current 24x7 technology landscape.

Asymmetric threats to enterprises

Asymmetry is the new term for an old concept, the reference for which goes back to Sun Tzu's "all warfare is based on deception". Asymmetric warfare deals with either of the adversaries in a war attempting to circumvent or undermine strengths of the other while exploiting weaknesses by using nontraditional tactics and technologies that differ significantly from expected methods of operation.

Asymmetric threat is used to describe 'unusual', 'irregular' or 'unmatched' threat, or a threat that is difficult to respond to. The great virtues of the Internet—ease of access, lack of regulation, vast potential audiences and fast flow of information—are being widely used by groups for asymmetric warfare. Lack of appropriate security assurance mechanisms invites these attacks with a crippling impact on digital enterprises. Traditionally, security has been based on perimeter defense. This has matured into a 'defense-in-depth' strategy, but it has not been realized by many. The proliferation of IoT, cloud and digital surfaces has further diluted the ability of enterprises to monitor and defend their assets.

Enterprises need to develop smart security mechanisms that are dynamic, intelligent and can detect and respond to ever-morphing cyber threats.

State of security with stateless architecture

Enterprises are moving to exploit the potential of next generation commerce with the aid of cloud, IoT, and a multitude of digital surfaces. This has resulted in enterprise assets being hosted on various platforms like IaaS, PaaS and SaaS with 'service statelessness'. Enterprises have not necessarily architected their services to secure data in this 'service statelessness'. Moving away from a 'stateful' to a 'stateless' architecture has resulted in economies of scale and various other benefits, but it has not translated to appropriate management of risk and security related issues.

Smart security calls for enterprises to create a dynamic function that enforces the PDCA (plan-do-check-adjust) model and manages risk effectively. Enterprises will need to (re)engineer and (re)architect their enterprise architecture to secure their DevOps function and enforce controls for:

- Effective authentication and authorization
- Dynamic and ongoing threat assessment
- Real-time and in-line threat detection and monitoring
- Real-time and in-line fraud and risks monitoring
- Secure DevOps
- Dynamic security architecture function

Operational risks

Cyberattacks pose a threat to brand value, consumer confidence and result in financial loss. In addition, the threat of action and penalties from regulators brings a sense of urgency to addressing operational risks. Now, security is at the top of the enterprise agenda.

Based on risk appetite, enterprises will have to define new risk models that are aligned with dynamic threat scenarios. They will need to establish a dynamic security architecture function that reengineers processes to deal with ever-changing threat scenarios. Dynamic threat models will have to be derived in-line with threat scenarios.

It is of paramount importance that enterprises reevaluate their cyber resiliency and cyber risk governance strategies in the context of dynamic risk models with a dynamic function addressing the following key operational issues:

- Risks and threats from malicious and negligent employees
- Potential risks from service providers [SaaS, IaaS, PaaS] and technology vendors
- Data exposure from third party outsourcing
- Risk management of IoT products, forensic remediation practices and simulation of cyber incident response

Approach to smart security

Smart security is about using cognitive, analytics and automation capabilities that enable enterprises with the required adaptive ability and near real-time responsiveness to respond to threats, defend enterprise assets and enhance resiliency (see Figure 21).

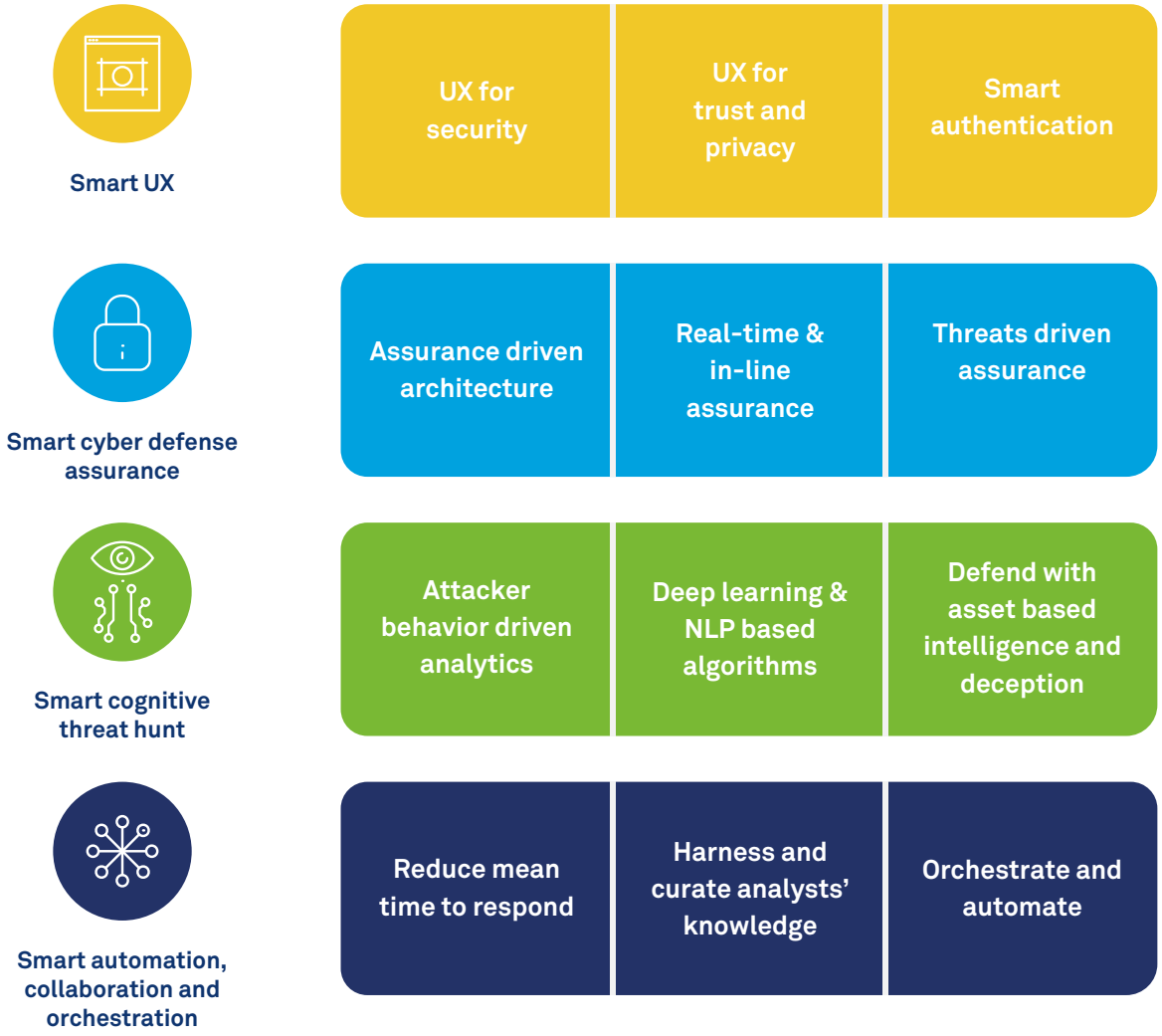

Figure 21: Capabilities for building smart security

Smart user experience (UX)

Enterprises adopting the 'direct-to-consumer' model are rethinking the UI Design and UI experience. However, the involvement of security architects to address cyber threats on the UI, interfaces, APIs, third party systems, service providers, etc., is insufficient. This will change if top management re-enforces the appreciation of security as an enabler.

Enterprise architecture functions have also failed to involve the end-users, who own and govern the endpoint, as much as they should. End users are crucial in making systems and hence the experience more secure. Enterprises will need to change their approach and invite their end-users to enforce, develop and enhance user experience and security.

Consumers connect with an enterprise using a vast variety of devices running on varied operating systems and networks. They use multiple applications and APIs. Together, these add to the risk factors and increase the complexity of managing risks.

To counter the rising threat, enterprises will use smart authentication platforms that offer multi-modal and multi-factor authentication combined with AI. The smart authentication platforms will leverage behavioral profiling, threat and user behavioral analytics, situational elements, and other parameters to raise security

standards without impacting user experience. In fact, these systems will improve user experience by proactively monitoring digital surfaces for data breaches, potential frauds, identity theft, etc. These systems will dynamically and automatically traverse the authentication and authorization journeys, using the most appropriate security measures and authentication processes.

Smart cyber defense assurance

The dynamic nature of threats is giving rise to newer threat models that demand fresh controls to defend assets as well as modifications to existing controls. This has a domino effect. The new models require an overhaul of enterprise security architecture—a function that is also being forced to become dynamic.

The changes call for a tighter correlation between the security architecture function and the cyber defense assurance function. The processes and the way to measure, evaluate and assess existing controls must be reengineered. With security assurance becoming the focal point, it is akin to setting up a new security game plan for the enterprise.

Enterprises will have to adopt newer technology controls for a better defense posture. These will have to continuously (re)engineer cyber defense in-line with the changes in threat scenarios.

The new assurance model would look like this:

- **(Re)Assess**: Look at current controls and map them to the dynamic threat landscape
- **(Re)Evaluate**: Examine existing controls for their effectiveness in various threat scenarios
- **(Re)Architect**: Architect the controls to the latest threat models or bring in additional compensatory controls for effective defense
- **(Re)Engineer**: Engineer the controls to meet the demand

Finally, an enterprise will find it easier to navigate the new threat landscape when it identifies meaningful metrics to drive decisions leading to effective cyber defense posture.

Smart cognitive threat hunt

Threats are emanating from a multitude of actors (state sponsored, individuals, corporate sponsored, rogues, cyber criminals, motivated individuals, etc.). The problem that security analysts face in the context of threat hunting is not a lack of, but a surfeit of data. The data is in different forms—structured, unstructured and hidden. To wade through the vast volumes and variety of data, enterprises will rely on cognitive platforms equipped with NLP and deep learning algorithms. These platforms get trained using 'reason' and 'business context'. A continuous feedback loop ensures that the platforms keep learning and improving, reaching a point where they begin to mimic human experts hunting for real-time and in-line threats.

Cognitive threat hunting platforms will enable an enterprise to analyze existing information and combine it with external threat intelligence to provide real-time attack visibility. Using this, an enterprise can take action to counter the threats with appropriate defense measures.

Smart automation, collaboration and orchestration

Enterprises face a multitude of daily threats. These need to be investigated thoroughly. Information and data must be correlated between various systems, administrators and analysts, prior to a decision being taken to respond to the threat. The decision-making also requires effective coordination between internal findings and external sources of intelligence and knowledge. Most enterprises, however, do not have mechanisms in place to coordinate and orchestrate these responses.

The security operations teams, led by analysts, deal with a plethora of information from various sources. They are handicapped by the lack of knowledge, expertise, precedence, coordination and information flow between security and non-security enterprise assets. The ramifications of these handicaps can be severe.

The solution is to adopt AI and ML-based security automation, orchestration, investigation, collaboration and case management platforms.

Security orchestration involves interweaving people, processes, and technology to strengthen security posture. By streamlining security processes, connecting disparate security tools and technologies, and maintaining the right balance of bot-powered security automation and human intervention, security orchestration empowers organizations to effectively and efficiently carry out threat hunting and incident response.

Security automation can provide complete visibility, triage events, connect the dots, and automate workflow processes. Effective automation of routine tasks increases the productivity of the security team. But to do their jobs, analysts need a comprehensive, single-pane security orchestration platform to achieve a balance between human intuition and automation.

These platforms perform two functions: first, to reduce an organization's risk profile; and second, to make the security team more responsive and productive.

The dynamic nature of threats is giving rise to newer threat models that demand fresh controls to defend assets as well as modifications to existing controls.

Smart security ecosystem

Enterprises should aim to become more resilient to cyber risks. This can be done by designing a smart security and risk management ecosystem built to identify threats and risks in real-time and in-line. These threats and risks will need to be managed by cognitive platforms and smart processes that are designed to be dynamic and near real-time (see Figure 22).

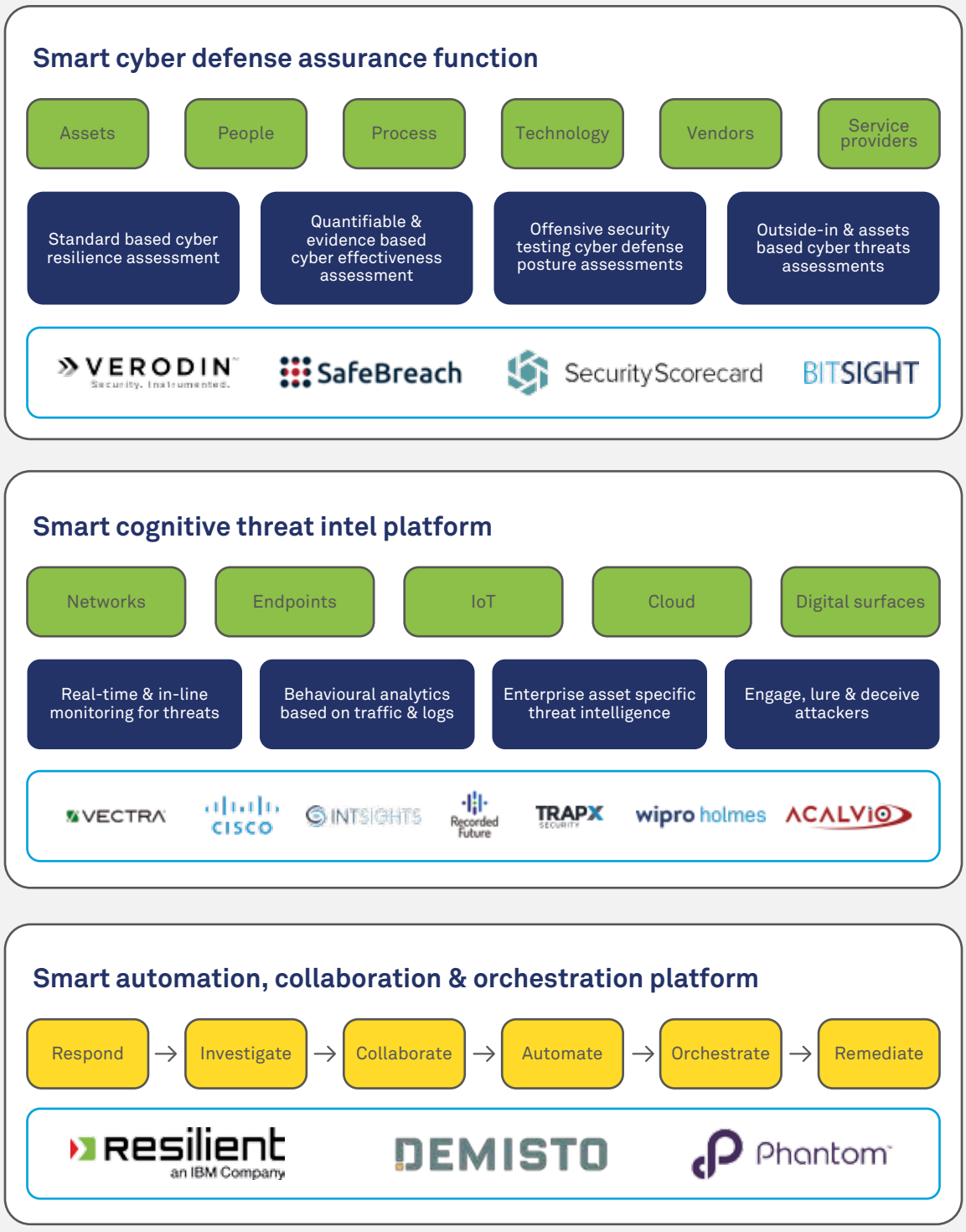

Figure 22: Smart security ecosystem

3.5 Bringing the smart imperatives together

As seen so far, smart application imperatives—smart interactions, smart processes, smart platforms and smart security—involve multiple distinct technology domains that cannot be treated in isolation. This presents a challenge of how to bring them together. Smart application imperatives need to be woven together to be effective. A cohesive architecture that connects these appropriately plays a key role in designing smart applications.

Architecture for smart applications

Architecture building blocks for smart applications will go beyond traditional architecture styles, leveraging several new technologies and architecture patterns. Enterprises will have to add these to their existing architecture capabilities. Briefly, **the key architecture styles (in addition to traditional architecture styles) that are vital to smart applications include:**

- Client cloud architecture
- Microservices architecture
- Reactive architecture

Architecture building blocks for smart applications will go beyond traditional architecture styles, leveraging several new technologies and architecture patterns such as client cloud architecture, microservices architecture and reactive architecture.

Client cloud architecture

This architecture style is a modern-day adaptation of traditional client-server architecture. Client devices are very capable now and can drive smart interactions independent (in a loosely coupled manner) of the server applications. Server applications are organized as services delivered on cloud, which can elastically scale and are highly concurrent. They are easily consumable by client applications from anywhere without compromising security. Several architecture patterns and application models are powering client cloud architecture to enable smart application delivery. These include:

- **Single page applications:** Applications built on modern day web technologies that use client-side frameworks to deliver adaptive and responsive user interfaces.
- **Push architecture:** Enables reaching clients proactively in real-time through web sockets and other messaging frameworks based on events and other observed patterns based on data.
- **Hybrid applications:** Applications designed using web technologies that are dynamically adapted to run on mobile devices and their capabilities as if they are not native to the device, offering portability across client devices.
- **Backend as a service:** Simplifies development of smart interactions such as conversational applications and MR applications. Developers can focus on experience, while backend as a service provides necessary backend capabilities such as authentication and persistence.
- **Serverless computing:** Simplifies development of event-driven applications such as conversational applications, adaptive processes, dynamic threat monitoring and contextual interfaces that act on events and action (example: speaking out a command or suspicious login attempt). It offers an easy way to host the actions as code functions.

Microservices architecture

Microservices architecture is fundamental to building modular applications. Each of these modules is organized as per business domain and can be developed, changed, operated and scaled independently. Smart platforms leverage microservices architecture, which make them extremely agile, scalable and autonomous with the ability to evolve with technology change. Microservices architecture enables applications to be composed of multiple services, which is key to bring smartness and agility into business processes. Flexible orchestration of services plays an important role in delivering smart processes. Building efficient microservices architecture, however, is complex and requires several architecture styles to come together.

- **Containers:** These are the lowest level building block for hosting services in microservices architecture. Containers make applications portable across clouds and can be orchestrated together to create business applications that are extremely scalable and flexible.
- **Platform as-a-service (PaaS):** Handles all the complexity in building microservices architecture. Services are hosted and leverage the platform services from PaaS.
- **APIs:** Play an important role in making microservices and even legacy systems accessible to a variety of client applications, or opening them to partners.
- **DevOps:** Brings automation and makes the microservices architecture resilient by eliminating the associated complexity.

Reactive architecture

Events and data are two important pillars of intelligence in smart applications—be it implementing a smart process that can dynamically adapt to non-availability of a user or the smart security monitoring of network events, aimed at acting on suspicious events before they turn into threats. Reactive architecture is the most important architecture in bringing intelligent behavior to smart applications. This involves real-time or batch processing events to derive intelligence. Reactive architectures allow building of sense and respond capabilities that are applicable across industries.

- **Stream processing:** Involves processing large number of events concurrently in real-time to understand temporal and other behaviors of data. Stream processing is useful in many scenarios including real-time threat detection or when building context for personalization.
- **Event sourcing:** Improves resilience of applications by modeling application state as a set of immutable events, which can be stored, processed and queried.
- **Lambda & Kappa architectures:** Learning requires processing data in large volumes. However, that can slow down processes, rendering them useless to smart applications. Lambda and Kappa architectures scale event stream processing making it possible to apply ML algorithms in real-time to deliver intelligence.

Reference architecture for smart applications

The reference architecture for smart applications puts together all the architectural building blocks providing the capabilities required for realizing smart applications. Various architecture styles described earlier are represented here as architectural building blocks, which are organized along the smart imperatives. It is a ready reckoner of all the capabilities required to build smart applications. This reference architecture not only captures the capabilities that an enterprise should acquire, but also the key existing capabilities that are to be leveraged in building smart applications (see Figure 23).

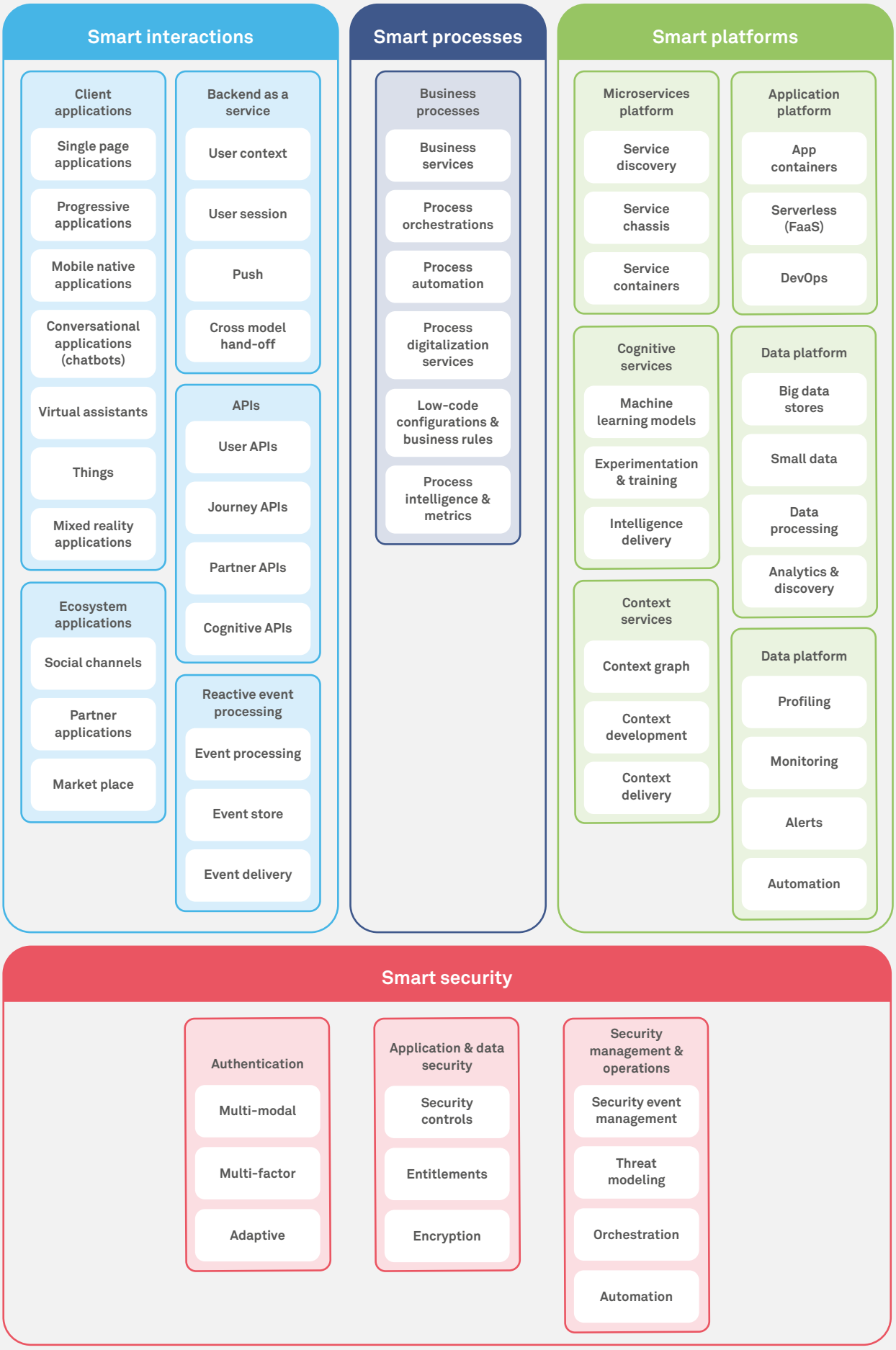

Figure 23: Reference architechure for smart applications

- **Smart interactions:** Businesses can deliver newer, innovative and immersive experiences through client application capabilities. These experiences can be delivered beyond the channels they currently control, through partners, social and other marketplaces using APIs. Backend as a service offers foundational services, while reactive event processing capabilities help in building user awareness.
- **Smart processes:** Process orchestration helps in assembling business processes by composing business services. These business processes can be configured through low-code platforms and business rules. Process automation minimizes manual touchpoints using RPA and augments humans with AI capabilities. Process intelligence and metrics improve the effectiveness of smart processes.
- **Smart platforms:** Microservices platform eases the creation of business services. Cognitive services provide the required learning and cognitive capabilities for smart applications. Context services process the data and deliver the context. Application and data platforms provide the capabilities to host applications and data. Autonomics bring autonomous behaviors such as self-healing and elastic scaling of applications.
- **Smart security:** Adaptive, multi-modal and multi-factor authentication capabilities enable smart authentication. Security controls play a key role in enforcing security adaptively. Capabilities such as event management, orchestration, automation are important in delivering DevSecOps, which helps build a security architecture that can defend proactively against complex threats.

The reference architecture for smart applications puts together all the architectural building blocks providing the capabilities required for realizing smart applications.

To illustrate the reference architecture let us consider the scenario of Alex buying a home. The example allows us to see how the architecture blocks from the reference architecture will deliver smart applications (see Figure 24).

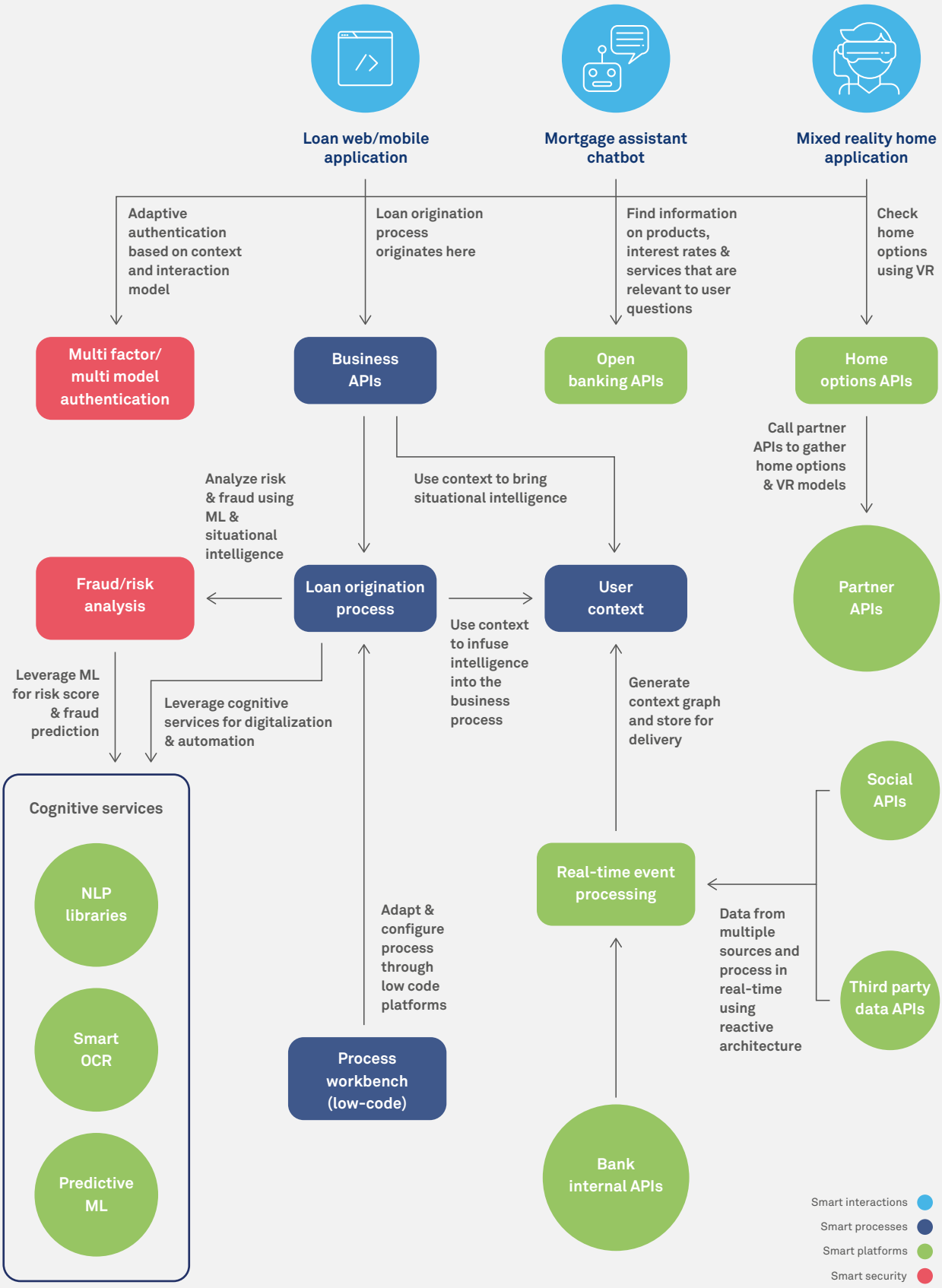

Figure 24: Architechure for smart banking

- Client cloud architecture is leveraged for delivering the immersive experience of buying a home through MR and conversational interfaces. Client applications communicate with services through APIs. APIs also enable communication with partners and integrate partner data into user interactions.
- APIs and services provide the necessary backend capability for the client applications. APIs further initiate the loan origination business process using microservices architecture running as a service.
- Reactive architecture is used for processing internal and external events to develop user context and situational intelligence. This drives intelligence into the loan origination process.
- Cognitive capabilities such as NLP and smart OCR are used for digitalization of user documents. This brings intelligent automation into the loan origination process.
- Adaptive authentication is used across the multi-model interactions. This leverages user context and other situational intelligence to adapt authentication.
- Business users use low-code application to rapidly configure and adapt the business process based on data and other insights.

The way ahead

Businesses need to bring intelligence into the experiences they provide, the processes they run and the operations that support business. Smart applications are important not only to stay competitive, but also to survive in the changing industry boundaries and business models.

The first step is to identify the opportunities for smart applications. An analysis of level one business processes will help identify such opportunities. The opportunities need to be tied to outcomes. It is important that these opportunities unlock benefits or bring positive change in the user experience in order to build a strong business case.

The next step is to assess gaps in an enterprise's existing capabilities to deliver smart applications. Such assessment should benchmark maturity capabilities across business, technology, data architecture, application development practices, DevOps practices, technology skills, and operating models. Identified gaps in maturity would serve as inputs for an enterprise-specific smart applications roadmap.

An architecture-driven transformation approach will ensure success. Prioritizing the portfolio for modernization, bringing together multiple disciplines of work, a structured buildup of new technology capabilities and, more importantly, tying them together with other strategic initiatives will play a key role in success.

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