

# CONTEXT-AWARE IT

Creating  
Personalized  
Software  
Experiences



**HORIZONS**  
by SAP

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# Welcome to **Horizons** by SAP



By **Christian Klein**, SAP SE

## Customer Expectations: The Next Generation of Software

We all want to be understood. As humans, we feel satisfied – even validated – when other people “get” what we mean, know we want, and foresee our challenges.

This level of insight and understanding is desired for more than just personal interactions.

Consumers of all generations have grown accustomed to the benefits offered by the digital assistants in our phones, homes, and cars. So the desire to extend this consumer-grade experience into the business environment should come as no surprise.

First and foremost, employees want the software applications they work with to be easy and intuitive to use. These tools should also incorporate and reflect knowledge about who users are and their role within the organization. Software should also anticipate what employees need so they can work faster, more efficiently, and more productively.


This knowledge of employees and their needs isn’t common in the workplace. Not yet.

In this issue of Horizons by SAP, we want to introduce you to innovative context-aware technologies. This broad range of tools, techniques, and solutions can help your enterprise systems improve the user experience for your entire workforce. By embedding context-aware technologies into your enterprise software applications, you’ll find new ways to help workers succeed personally and professionally – while meeting your business goals.

If this is your first time reading Horizons by SAP, I hope you’ll enjoy it as much as I do. Each annual issue is full of information about emerging ideas, business trends, best practices, and new viewpoints from some of the world’s top technology experts. The executives and thought leaders who contribute to it are among the best and brightest in business today. So welcome to the 2020 issue of *Horizons by SAP* – I wish you an exciting read.

Christian Klein is the CEO of SAP SE.

# Context-Aware IT

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Embedded Context Awareness Differentiates Solutions and Improves User Experiences



A woman's face is partially visible through a grid of blue hexagons. The hexagons are arranged in a pattern that frames the woman's face, which is looking slightly to the right. The background behind the hexagons is a blurred image of the woman's face and hair.

# Capturing a Personal Perspective

How Context-Aware  
Software Can  
Augment and  
Support Human  
Workers



By **Max Wessel**, Chief Innovation Officer, SAP SE

## By collecting and considering more-relevant data, business software can help people work faster and more effectively. But are we ready for a consumer software experience in the workplace?

Think of the “computer” in your pocket – your mobile phone. It knows so much about you and what you’re doing, what you may need next, and how to get things done more efficiently.

You open your Uber app and it knows where to send a car for pickup. If you sign onto social media, Facebook or Instagram shows you relevant content based on your personal interests or those of your friends. When you send an e-mail that mentions an attachment, it reminds you to attach the file.

These personal applications are context-aware. They use the data you create to deliver a perfectly tailored user experience. And we love that, right?

Here’s the interesting thing: Enterprise software does not naturally deliver that sort of experience – today. But that is about to change.

### Context-Aware Versus Intelligent

Humans experience things with an awareness of their context. We understand the place that we’re in and whom we’re engaging with. We know what came before – whether it was the last part of a conversation or some other interaction – and we can anticipate what is coming next. There’s a sense of continuity in our experience that helps us understand how we should adapt and react to new stimuli.

At work, we do best when people understand us. We are more likely to achieve our goals with teammates who understand and respect how we work, receive input, and prefer to engage. All of that requires context.

**Enterprise software can often be customized and configured**, but it typically is not context-aware. Here’s what I mean: While an app might show me information that relates to me, such as a list of my preferred supply chain providers, the information isn’t likely to be in the context of what I am doing or what I need next.

For example, when I’m ordering products, an enterprise application might understand that I need to order a certain product from a vendor in my region. But in selecting recommended vendors, the software doesn’t take into account that my budget is under pressure this quarter and I need to limit my search to a specific price range. That’s especially true when the deciding factors are based on my latest e-mail correspondence and a disconnected financial system.

Context-aware software can take today’s so-called personalization beyond a superficial level toward one that actually amplifies and augments human output. If my app recognized my situation and constraints, it might suggest the vendors with the characteristics and capacity to meet my requirements – even if I have no existing relationship with them.

Context awareness is also different from intelligence, which many companies are trying to build into their software. Intelligence is created when algorithms or decision criteria are used to take action on a particular set of data.

Let’s say you know that sales rise when it rains. If the weather forecast predicts three consecutive days of rain, you could expect to sell more merchandise. The intelligence built into your software could help you determine which merchandise you should stock to meet the anticipated higher sales demand.

But it rarely considers the context around your operations. Imagine you are located in Las Vegas, which gets minuscule amounts of rain each year. A predictive model might be right in suggesting that you will sell more umbrellas on the days that it actually does rain. But because the humans around your stores understand their context more broadly, they may not buy too many umbrellas based on the local expectations that they won’t need them in the future. No matter what the data suggests, selling exclusively umbrellas in Las Vegas is a bad idea.

Personalization and intelligence don’t equal context awareness – but they are both prerequisites for it.

### A Higher Standard for Enterprise Software

Consumer apps understand context because they have access to the user’s position, browsing habits, and past behaviors. Most consumers allow applications access to their inbox, messages, or push notifications. Information gleaned from these resources provides companies with even more context and data.

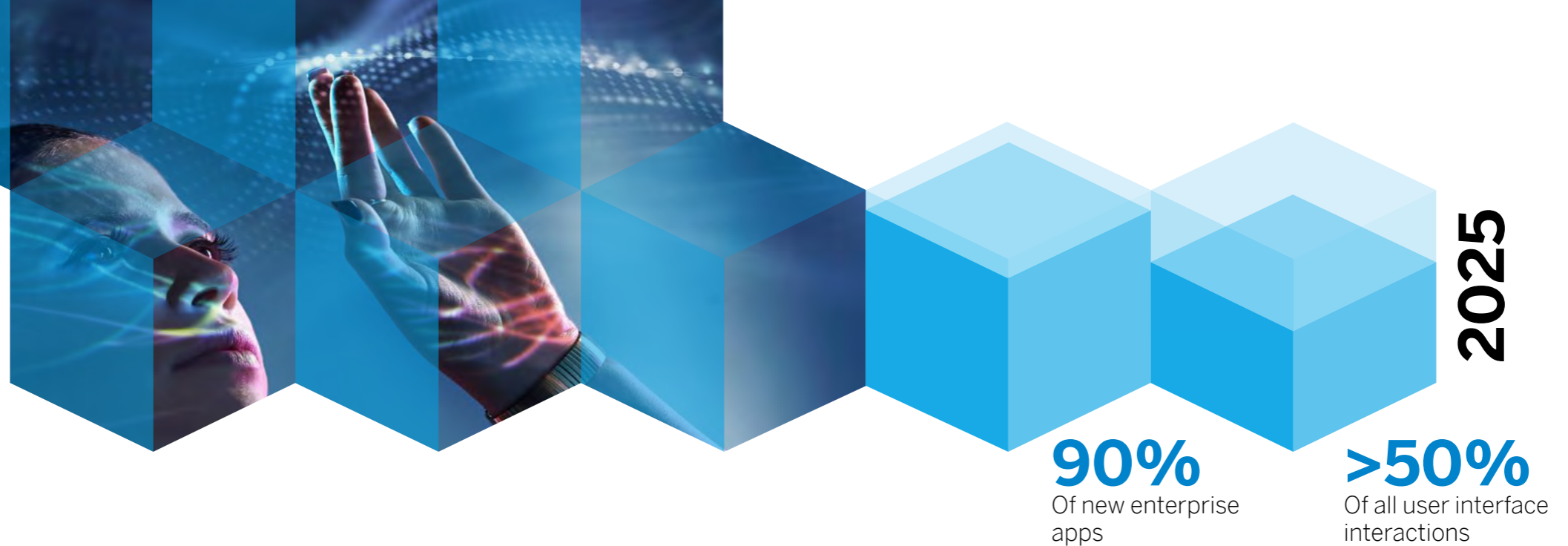
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Workers want the same usefulness in their work tools that they experience in their consumer software.

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## Facilitating Context Awareness with AI



In the world of enterprise software, this type of data ingestion has more meaningful barriers. For one, data is regularly siloed. It's also unclear who has the rights to share it – the user or the company? Couple all that with regulatory issues around data sovereignty and you have a perennial challenge. **Simply put, in an enterprise environment, collecting context-relevant data is more complicated than clicking a terms and conditions bubble.**

Enterprise vendors also face the challenge of enriching legacy IT systems with context awareness. It's not enough to provide context awareness only to new technologies or greenfield deployments. Vendors must also deliver innovation that adapts, enriches, and future-proofs the investment customers have already made.

Also, new data encryption models and innovative types of data security are coming to market. We'll also have to deal with data sovereignty issues across geopolitical boundaries to ensure that data stays in the right places and is accessible by only the right parties. One of the biggest differences between the companies that will succeed in the next decade and those that won't will be how effectively they are able to think about technology, ethics, and data privacy in a holistic way.

To illustrate this, let's examine one of our most important investments: Anonymized user behavior tracking. With it, we can monitor and analyze user activities independent from the user interface while still acting as strong stewards of user data. This technology anonymizes data, clusters it, understands specific data flows, and ultimately makes recommendations on how to simplify or even automate processes using that data.

Because we've determined how to monitor context, we can watch how customers use their SAP® software and predict what a user is trying to accomplish with a given task flow. We can identify when a user is trying to enter a supplier invoice and see that it requires too many steps to complete the task. When this happens, we know that something in the user's system configuration was set up inappropriately, so we can automatically identify the problem and improve the process.

Current enterprise solutions tend to capture only transactional details. As the technology matures, expect to see more instrumentation around context that answers such questions as: When did the transaction occur? What was the weather like? What happened immediately before or after the transaction?

By blending these different sources of data together, we can consider all of the relevant information and increase context in the decision-making process. That's a big improvement from a technical perspective.

### Looking Ahead

Considering our increasingly fragmented value chain, it is not enough to limit our focus to technology, privacy, and security challenges. We must also consider [ethical and moral implications of context-aware systems](#). Imagine a company uses SAP software to make decisions about payments. SAP in turn uses an external partner payment platform to provide payment processing recommendations. How do we ensure that there is end-to-end responsibility for the quality of the recommendation being provided by our partner?

As a software vendor, we have a lot of experience dealing with this. But if you're a large industrial business that's thinking about completely reshaping the way you go to market and service your customers, you're potentially using multiple software providers to help you execute. You must ensure that the right moral and ethical controls are in place, even in a newly digitized value chain. It's important to work with partners that invest the appropriate time into understanding your business. Otherwise, you may be unintentionally outsourcing your decision processes.

**As context-aware systems mature, more data integration will be used to inform how applications behave.** Identity models and enterprise data tracking will begin to resemble the consumer world, where data blends together across systems in a way that helps create better recommendations and supports better decision-making. That blending of information will likely extend to analytics, where users can create their own dashboards that pull information from multiple self-service systems.

The shift to context-aware systems is already beginning, driven by both workers and their employers. Workers want the same usefulness in their work tools that they experience in their consumer software. Companies will invest in context-aware systems because they will deliver value to their organization. Software that is more human – understanding the context in which things happen in the enterprise – will be the next step toward amplifying and augmenting what workers can accomplish.

“By 2025, AI will be inescapable: It will be a key ingredient in **90%** of new enterprise apps and **over half** of all user interface interactions.”\*

### Coming Context-Aware Features

How is SAP using context awareness to enhance its software? Max Wessel cites four areas of focus:

- **Multiparty collaboration** – giving users more context around what's happening in business systems
- **Identity modeling and user behavior tracking** – helping deliver more context to legacy systems
- **Backward-compatible instrumentation** – unlocking innovation across the ecosystem
- **Data anonymization and encryption** – enabling creative innovation even in regions or countries where data sharing is more sensitive

\* IDC, "IDC FutureScape: Worldwide IT Industry 2020 Predictions," Doc #US45599219, October 28, 2019.

# Technology Trends to Watch

## Voice Recognition

"Many virtual reality (VR) interactions require you to point at something with a device. It's a little bit clunky, and people just aren't comfortable with it. I'm curious to see what our VR team will be able to do with virtual spaces by merging voice commands and virtual reactions together."

Katharina Borchert,  
Chief Open Innovation Officer,  
Mozilla Corporation

## Workplace Intelligence

"Organizations will continue collecting more data and using tools such as artificial intelligence and machine learning to realize new insights. I've seen some prototypes where AI-enabled assistance technology assesses the content of an e-mail and proposes a multi-paragraph response that users can accept or modify. More and more, these innovations will help make work easier and less burdensome, so workers can be more productive."

Ryan Fuller,  
Corporate Vice President,  
Microsoft Corporation

## Privacy

"Companies are going to need to treat data like a financial currency. The regulations will force their hand. But the opportunity is being able not just to better safeguard that data and get more value from it, but to ultimately reduce their costs as they move to the cloud."

Dimitri Sirota,  
CEO,  
BigID Inc.

## Design Considerations

"Designers need to understand how different interaction models work, when they make sense to use, and when they do not. Conversational interactions that support speech are great, but you wouldn't want to use them while working at the airport."

Alex Lingg,  
Head of SAP User Experience,  
SAP SE

## Ethics

"We will see more research into the measurement of a company's ethics and integrity. Our institute is already developing instruments to measure how ethical a company is."

Christoph Lütge,  
Director of the Institute for Ethics  
in Artificial Intelligence,  
Technical University of Munich

## Virtual Infrastructure

"We're applying intelligence to infrastructure solutions – taking a decade of machine learning and applying that to self-driving data centers so that system administrators can take care of more important stuff than just keeping the lights on."

Muneyb Minhazuddin,  
Vice President, Solutions and Product Marketing,  
VMware Inc.

## Software-Defined Networks

"The DevOps world allows companies to rapidly make small changes, adapt to evolving environments, and work quickly with operations. Now the network can be part of the equation. We call it NetDevOps. Leading companies are exposing the network, through APIs or other channels, so that applications can communicate directly with the network. It's a continual innovation program."

Debika Bhattacharya, Vice President, Global  
Solutions, Verizon Business Group,  
Verizon Communications Inc.



# Listen Up

Democratizing  
Voice Technology  
for More Personal  
Human-Machine  
Interaction





By **Katharina Borchert**, Chief Open Innovation Officer, Mozilla Corporation

## Voice recognition offers opportunities for new innovations that could create a better world. How can open source communities make sure the technology reaches everyone?

German composer and conductor Richard Strauss once said, “The human voice is the most beautiful instrument of all, but it is the most difficult to play.” Although Strauss was likely commenting on one of his opera singers, today’s technology firms are also encountering the highs and lows of employing human voice to create more personalized interactions.

**Voice recognition technologies can help create engaging user experiences by providing a natural, seamless way to interact with a broad range of devices.** Voice is easier to use than typing or touch screens, lowering the barrier between us and our devices.

Most people are familiar with voice-enabled technologies such as Siri from Apple, Amazon’s Alexa, Microsoft Cortana, and Google Voice. They use these technologies to find information, order food, schedule appointments, play music, or watch a television program. In just a decade, voice technologies have evolved from an entertaining novelty to a commonly used tool for many consumer applications and certain enterprise solutions.

### Inclusivity Limits

Despite this evolution, progress in deploying voice is not as great as many of us had hoped. The majority of voice technology initiatives are under the control of a few leading companies, who started early and have dedicated extensive financial resources to development. Most voice data is expensive and proprietary. And developers need an enormous amount of data to build voice recognition applications.

To maximize their potential user base and monetization opportunities, those companies focused on developing technologies in dominant languages such as English and Spanish. They built data sets to support voice recognition by machines. However, most of the voice samples were created by trained speakers – males communicating in their native language.

As a result, voice technology has not been particularly inclusive – in terms of the variety of speakers and the languages spoken. For example, an Austrian friend who speaks both English and German has trouble with her smart speaker. Because of her heavy Austrian accent, the virtual assistant doesn’t understand her when she speaks either language – no matter how clearly she enunciates each word. She relies on her children, native English speakers, to give commands.

**Most of the leading companies will not build technologies for smaller, underrepresented languages. This is unfortunate, because language is important to people’s cultural and political identities.** While English has become the lingua franca of the Internet, it’s not the same as having technologies in your own language.

By focusing on a handful of dominant languages for voice technologies, we risk losing much of the cultural richness of our interactions with the world. On a more practical level, extending the reach of voice recognition to less popular languages could open the doors to new innovation. Think about the regions where literacy rates are still relatively low and interacting in writing is an inhibitor to technology use. Our hypothesis is that voice technology could unlock huge digital potential for an audience that hasn’t been broadly included in digital knowledge until now. The potential upside for the digital economy could be profound.



### Open Source of Innovation

Our solution to this challenge is to call on the open source community to help democratize voice technologies by improving voice recognition and natural-language processing algorithms. But there are clear barriers to open source innovation.

Developers need a voice technology stack, including a training database that teaches machines how to understand language. Included in the database must be training data – the more, the better. The established companies have this data, and developers can license it. But it is typically available only in a limited range of languages. And if an application becomes successful, the licensing costs for the data become prohibitively expensive.

To address these challenges, Mozilla created a technology stack to help make voice recognition open and accessible to everyone. Our database, [Common Voice](#), is being created using an online platform that allows volunteers to read a sentence in their language.

“Voice technology could unlock huge digital potential for an audience that hasn’t been broadly included in digital knowledge until now. The potential upside for the digital economy could be profound.”

The platform collects the voice samples into a single data set. Other volunteers check the work of contributors to verify and improve the quality of the collection. The data set currently includes hundreds of thousands of sentences – all validated samples – from more than 51,000 voices. And this data set is available to open source programmers. Any programming community that wants to begin building a language corpus in their native tongue can use this data set or even add to it.

As part of our effort to bridge the digital speech divide, we've also created an open-source automatic speech recognition engine, [Deep Speech](#). The technology was developed to make speech recognition technology and trained models available to open source developers. **By making voice data freely and publicly available, and ensuring that data represents the diversity of real people, we hope to make voice recognition technology better for everyone.**

The results of our projects are encouraging and sometimes surprising. In the early stages of the project, for example, we began working in English. As we opened the project to other languages, we expected to see the fastest pace of growth in commonly spoken languages such as German, Spanish, and French.

But remember, language can be political. About two years ago, our fastest-growing language was Catalan – which is spoken in northeastern Spain, in Catalonia, where political conflict was high. One way the Catalan culture has always surfaced is by using Catalan instead of Spanish. Our project showed a big community movement rallying around Common Voice and contributing language samples in Catalan. That's something we hadn't expected.

We shouldn't have been surprised. Software always has a strong cultural element, whether or not it's recognized. Software is supposed to be neutral, but we should recognize that it also makes implicit cultural value statements and judgments.

## A Level Playing Field

**Whether we build business-to-business or business-to-consumer software, voice recognition technologies will be an essential part of technology for the foreseeable future.** That becomes problematic when only a few companies hold the resources needed to deploy voice recognition into applications. What's more, the fact that their large consumer base consistently interacts with their devices means that these companies are light years ahead of the competition in terms of collecting more-diverse language samples.

Companies with no in-house voice technology become increasingly dependent on the four or five leaders. These firms can set the price of their technology and they can determine whether or not users should have any expectation of privacy for their data. That's an issue – for Mozilla and for me personally.

We know that voice recognition technologies can listen to us at any time, even though they are only supposed to respond to “wake words.” Anonymized cloud recording is not always anonymous. We know that samples are collected and stored even when users have not spoken the wake word. In some cases, police have been given access to recordings for legal proceedings. All companies – and all individuals – should be concerned about these privacy issues.

Having an open source alternative that does not contribute to the dominance of these companies would be worthwhile. Technology becomes more innovative when it isn't controlled by a small group of companies on a predetermined path. From our experience building the Firefox open source Web browser over the last 20 years, we know that some of the best product innovation comes from users and open source developers. Successful open source technology is, by its nature, available to a broad range of developers and entrepreneurs. It's the fast track to a more vibrant ecosystem and a brighter digital future.




## AI for a New Voice Recognition Challenge

The German government recently announced €1 billion in funding for artificial intelligence (AI), and Mozilla is working with the government to test hypotheses about underserved languages in emerging markets. As part of this process, we began building a language database in Kinyarwanda, the national language of Rwanda, which is also spoken in the Eastern Democratic Republic of the Congo and nearby parts of southern Uganda.

This language and others like it pose an entirely new set of challenges for voice recognition technology, because many of the sounds used have no analog expression in writing. Tones or sounds made by the tongue require a different kind of training for machines to understand.

In Rwanda, we're seeking startups or small companies that want to build voice technology into highly specific applications, such as agriculture or healthcare. Although our community faces different challenges than we anticipated, it will be fascinating to see what we can build to address these use cases.



**Name one thing that  
intelligent technologies  
should never know  
about you.**

I have a fitness tracker,  
because I like to see my  
steps and my heart rate.  
But I will take it off the  
moment someone invents  
the automatic tracking of  
my snacking habits.

Katharina Borchert, Chief Open Innovation Officer,  
Mozilla Corporation

# UX Design

Five Principles  
for Creating  
Unique,  
Flexible User  
Experiences





By **Alex Lingg**, Head of SAP User Experience, SAP SE

## By redefining the way we design enterprise software, artificial intelligence is helping developers make solutions more meaningful and personal for today's users.

Artificial intelligence is changing the way we work. Moving away from the traditional paradigm of humans operating machines, AI transforms the interaction between humans and machines into a dialog between partners with complementary skill sets.

Designers were among the first to understand the potential of AI to improve the experience of individual users. Design provides users with more meaningful information and options that can help them master complexity. In the past, however, intelligent designs added complexity to the user experience with features such as relevance ratings, recommendation options, confidence ratings, and incompetent chat bots. This led to user frustration and mistrust.

**After all, people aren't interested in cool technology features. They just want the best way to do their work.** Users expect AI to function in an unobtrusive, reliable way. At the same time, they want to be able to understand, correct, and override intelligence if needed.

To meet these needs, designers must support a seamless collaboration between humans and machines, where both use their specific strengths to support one another – but humans retain control. We have developed a [set of design principles and guidelines](#) to establish this approach in our solutions.

### New Interaction Techniques

AI provides a huge opportunity to combine traditional means of interaction, such as mouse and keyboard, with new techniques, such as gaze control and conversational interaction. Today, none of these methods are well-developed enough to replace the others, but combining them can become a game changer.

Gaze control can increase speed and productivity by offering additional information on the user's focus. This supports easier selection and filtering, contextual information, and more detailed information. Conversational interaction allows users to express their intent in their own words and allows systems to translate these aims into an appropriate response. All of these channels help designers widen and enrich communication between humans and machines – supporting more intuitive, immediate, and bidirectional communication.

More than ever, technology has become a social force, and design is shaping the way this force interacts with people. Enterprises communicate their values not only through marketing messages, but also through technologies used by their employees and customers.

Therefore, purpose has become a larger focus for enterprises. Questions like “Why are we doing things?” and “Are we doing the right things for the right purpose?” have assumed a higher priority. **Design can influence the interaction between businesses and their employees and customers. This influence goes beyond corporate identity and marketing and reflects how decisions are made and communicated.**

To empower the workforce and gain employees' commitment to enterprise purpose, design must create software that reflects respect and transparency. Therefore, spending time explaining actions and decisions should also be part of the user interface design.

### Designing for the Everywhere Interaction

Today, the combination of smart devices and appliances covers a good part of our interaction with our technical infrastructure. Technology is embedded in our daily lives, creating the user experience of the digital world. We interact with the most complex systems through any available channel, in any possible situation.

Enterprise software is following suit. Business tasks are already becoming accessible through **standard interfaces embedded into other channels**, such as smart speakers or car interfaces. With the SAP Fiori® user experience, we have started breaking down complex business tasks into smaller apps that can be completed on a phone. We are reducing the information even further by identifying specific figures that users need in each context and allowing users to adjust figures to their individual needs, securely and reliably. Thus, **modularization** and **contextualization** of complex information structures in the back end is both a design and technical challenge.

**While users expect simpler and more natural interaction with software, the underlying facts and processes are getting more and more complex and intertwined.** This is apparent in enterprise software, where we are exploring the potential of new **visualization and input methods**. We are looking beyond charts into multidimensional visualizations and AI-optimized visualizations that differentiate signal from noise. Using predictive technologies and combinations of input methods, including gaze and speech, enables better accuracy and faster input than traditional means.

Finally, constructing and harvesting **context information** is one of the most powerful tools to simplify user interactions. Based on context, systems can detect business process exceptions and associate combinations of parameters with business impact and suitable mitigation. With a better understanding of the business context, the system can detect, confirm, and correct the machine's interpretation and solution proposal without requiring the user to manually enter data.



“

Designers must support seamless collaboration between humans and machines, where both use their specific strengths to support one another – but humans retain control.

”



## Top 5 Design Principles

To address these current UX trends, I recommend that developers focus on five key design principles.



### Understand the user and the use case

This is the most important principle. Creating a product must be focused on the people that will use the product to accomplish their task. Neither architectural nor design excellence will help save a product that misses the use case.



More natural interactions tend to build user trust in the software.



### View limitations as a source of innovation

While boundary conditions are often determined, many innovations have been triggered by a creative way of addressing those boundary conditions. Things we can't imagine today may be possible tomorrow.



### Embrace diversity

Enterprise software is an enabler for businesses, and we can't afford to leave anyone behind. Different people, working conditions, and cultures determine whether a solution is enabling or hampering productivity. Understand those differences and design for them by contextualizing them, creating specific variants, and offering supportive means and smart suggestions. Finally, offer the tools that allow customers to optimize standard solutions with little cost.



### Keep the user in control

At any given point in time, users must be able to understand and control the status of the system. User control means that system decisions must be clearly communicated and can be overwritten. Empowerment requires knowledge and transparency.



### Design stretch-fit solutions

Standard solutions that are designed for best practices and use cases can further be optimized to stretch fit individual roles and preferences by means of usage-based optimizations and through personalization and automation.



## Flexibility Versus Scalability

Many things that sound exciting in consumer software are not appropriate in an enterprise setting. Business processes must be standardized, reliable, repeatable, and auditable. And even if we strive for the best user experience for the individual, companies must ensure that people do things the right way.

Training and supporting employees require stable, standardized processes and software. Required process steps, checks, and information must be entered correctly and, in most cases, can't be left to the indeterministic decision of an electronic mind. Therefore, corporations tend to restrict flexibility and leave adjustments in the hands of certain expert users. Flexibility can only be offered within clearly defined boundaries, leaving the underlying business processes unchanged.

**The highest potential for individualization is the contextualization that helps provide users with right solution options and defaults in any situation.**

While the process stays unchanged, the system becomes better at providing the right information at the right place, offering the right options that best fit the situation.

Today's technology allows us to design systems that better understand users' intentions and support them in the best possible way, keeping them in control. Yet flexibility must allow the system to adjust to the user's information needs and intentions without compromising the procedural, legal, and economic goals of the enterprise.

In enterprise software, innovation in interaction patterns must be evaluated against the impact on employee productivity. Unless we identify significant improvements in effectiveness or efficiency, using established

standard patterns that require minimal training and change management is preferable. In many cases, the challenge in enterprise design isn't coming up with an innovative and appealing new design, but is optimizing and extending standard designs to meet the complex and specific requirements of certain business roles.

The art of our profession is creating a design system built on components and patterns that are simultaneously stable and reusable in various business contexts, work with long and short texts in different languages, are accessible, and can efficiently be used across different devices. This is a huge and often underestimated investment.

We implement scalability in design into our technical frameworks. This helps us and our customers create and maintain effective, efficient solutions at the lowest possible cost of development and ownership.

Our role as designers is to make sure that our products make the best use of our design system, are constantly optimized to fit user needs, and can be implemented in a scalable technology framework. As we have seen with SAP Fiori throughout the past seven years, this is an evolutionary process that requires continuous investment.

And design is just a part of the story. For us this means working closely with our product units, customers, and development teams to adjust our designs to best accommodate user requirements, market needs, and technical restrictions.

We don't design for the purpose of good design. Instead, we design to create products that help our customers best support their business – making it sustainable and resilient to any turn of history.

**If you were stranded on a deserted island with just one smart device, what would it be?**

“

I'd bring a Swiss Army knife – you know, those tiny multitool knives you can carry in your pocket? In a world with no electricity and no Internet, you have to go back to physical smart devices. You can do a lot of things with a Swiss Army knife.

Alex Lingg, Head of SAP User Experience, SAP SE



# A Flexible Backbone

Designing a Computing Infrastructure for Speed, Security, and Innovation







By **Muneyb Minhazuddin**, Vice President, Solutions and Product Marketing, VMware Inc.

## Management complexity rises as enterprises increasingly build and deploy new cloud-based applications. Can virtualization do for applications what it did for computing hardware?

Pressured by the successes of digital challengers – startups and nimble smaller organizations that are unburdened by legacy technology infrastructures – established enterprises are rethinking their business models, processes, and supporting IT solutions. To adapt more readily to dynamic market conditions, businesses need technology that is simpler, less complex, and more flexible. At the core of this new approach is a focus on enterprise software applications.

Most organizations have hundreds of applications, and some use thousands. That seems like a huge management challenge, and yet the complexity continues to grow. In fact, the number of applications we build and roll out in the next five years is expected to be greater than the volume we've deployed in the last 40 years.

In the past, applications conformed to the available infrastructure. Companies designed their networks, administrators racked up the servers, and developers wrote code to those specifications. Everyone knew how to run, manage, and secure those types of networks.

Today, that certainty is gone. **The current explosion of applications is largely based on cloud technologies built on containers and microservices. They are designed to meet new and changing business requirements, but they don't necessarily conform to any particular infrastructure. As a result, all of the principles, guidelines, and processes need to change.**

This is where software intelligence and context-aware IT infrastructures can help. Building context awareness and intelligence into the infrastructure can drive powerful new efficiencies that help organizations work more productively, maximize the advantages of all of their applications, and protect their networks.

### Rising Application Complexity

Many companies are hurriedly migrating to the cloud. One retailer anticipated huge volumes of bursty traffic from its Web site during the year-end holidays. Rather than building new on-premise infrastructure, the company planned to relieve some of the pressure by moving certain applications and workloads to the cloud.

Because the retailer didn't consider the context of the entire sales application universe, things started to go wrong. Customers began to make Web inquiries, but the now cloud-based application lacked connectivity with the supply chain applications. Requests couldn't consider order backlogs.

The retailer needed to consider the context of how sales processes affected other parts of the business, such as supply chain and enterprise resource planning. Without the right interactions with related back-end processes, the cloud-based application couldn't efficiently handle the order volume. **In hybrid environments, enterprises must leverage context and intelligence to create efficient processes.**

There's one more significant issue. Companies with hybrid infrastructures are experiencing unprecedented levels of security breaches. Often companies try to apply the same security framework to hybrid environments that they used for their client-server infrastructures. Unfortunately, these security approaches cannot scale effectively in hybrid environments.

Yet the explosion of applications is creating huge volumes of data – in some cases, billions of data signals each day. It's impossible for organizations to manually sort through so many signals, so they begin to filter them. Often filtering is insufficient to identify and isolate real threats.



Instead, enterprises need to create security intrinsically, deploying a security posture across applications and data that scales in native cloud environments. By assessing behavioral patterns in the application context, the enterprise can apply intelligence to threat response – helping companies reduce attacks by 90% or more.

### Application Abstraction for Cloud Deployments

VMware has been tackling the challenges of data center infrastructure complexity for 20 years. As an early virtualization leader, we abstracted compute hardware and fabrics. Now we are guiding companies through new challenges in their application landscape.

Often our clients deploy cloud-based enterprise applications that fit their business needs, almost without regard for where the software executes. As a result, most companies run an average of four to five clouds, including hyperscalers such as Amazon AWS, Google Cloud Platform, and Microsoft Azure. This creates infrastructure-wide management and maintenance issues. More of the enterprise data resides outside of the data center, creating worries about how it can be secured. And employees want to access all of these applications, often from their own devices – requiring companies to support a wide variety of end points and mobile platforms.

“Building context awareness and intelligence into the infrastructure can drive powerful new efficiencies.”

By building cloud-based applications in this environment, many companies commit themselves to certain infrastructure choices. Imagine that a developer chooses a particular application programming interface (API) and uses it to quickly write an application. The solution is up and running quickly, which is great. But that API might only run on Google Cloud Platform or AWS.

To address this, VMware developed the same kind of abstraction layer for application development that we created two decades ago for hardware and data centers. **By abstracting the build and run component of these modern applications, our technology allows enterprises to pick a onetime run platform and run the application in the data center, on the public cloud, or in a hybrid environment.**

The virtualization technology, which is part of the VMware Tanzu portfolio of products, allows companies to build new cloud-native applications, modernize existing software, manage cloud-native applications and microservices, and operate infrastructure that serves all of the applications across any cloud.

Role-based access allows administrators to view the infrastructure, set up storage, create networks, and assign resources. DevOps team members can define workspaces, name spaces, and application clusters. The tool brings administrators and developers together so they can work efficiently and in pursuit of the same goals.

Application developers benefit from accelerated workflows because the technology provides a consistent dashboard, exposes the right APIs, and offers useful tool sets. The technology also offers an automated blueprint to developers and reuses valuable code from a catalog of custom-developed software and cloud-native services.

Data center administrators gain value from technology, such as a lifecycle manager that automates the processing of operating system and application patches. Using machine learning, the solution tracks all levels of patches and deploys them automatically. Back-end intelligence helps the data center become largely self-driven – freeing administrators for more valuable work.

To bring the solution to market, we partnered with all of the main cloud vendors – including key hyperscalers and 4,000 service providers – to create a consistent infrastructure and operation platform that scales across all clouds. Partners run the VMware stack within their data centers. **Our stack virtualizes and automates all of the networking and storage, not just compute resources, allowing us to provide intelligent, context-aware infrastructure as a service.**

One client, a larger insurance company, used this new technology to migrate 300 applications from its internal data center to a public cloud. Originally the company estimated three months of labor for each application migration, or 900 labor-months at a cost of approximately US\$1 million per application. Using VMware solutions, the company migrated all 300 applications in just a few months – and at less than 5% of the original budget.

### Intrinsic Security

Virtualized technologies can also improve a company's infrastructure security. Three years ago, VMware identified a problem that's common to many enterprises: we had more than 100 security tools and they could not scale. With each new threat, it seemed we deployed an additional product. No one wanted to remove any of these tools, for fear that it might expose us to a security breach.

Using our own technology to create intrinsic security, we were able to reduce our collection of 100 security tools to just a dozen in two years. By building security into the key control points – such as networks, end points, identities, access, and users – we converted breach-sensitive areas into points of control. If those applications and data move to different clouds or become decomposed into container microservices for modern applications, we can still retain that security posture.

The security solutions understand the intent of an application and know when its operational state is positive. Using network intelligence to assess patterns, we can look for behavioral changes from the ideal state and respond to those – instead of chasing potentially

bad behaviors. Because all of the security tools communicate, we can see unwanted network activity and block it. In addition, the solution can automatically remediate problem areas. By abstracting, automating, and unifying our security posture, the technology delivers security built on intelligence and context awareness.

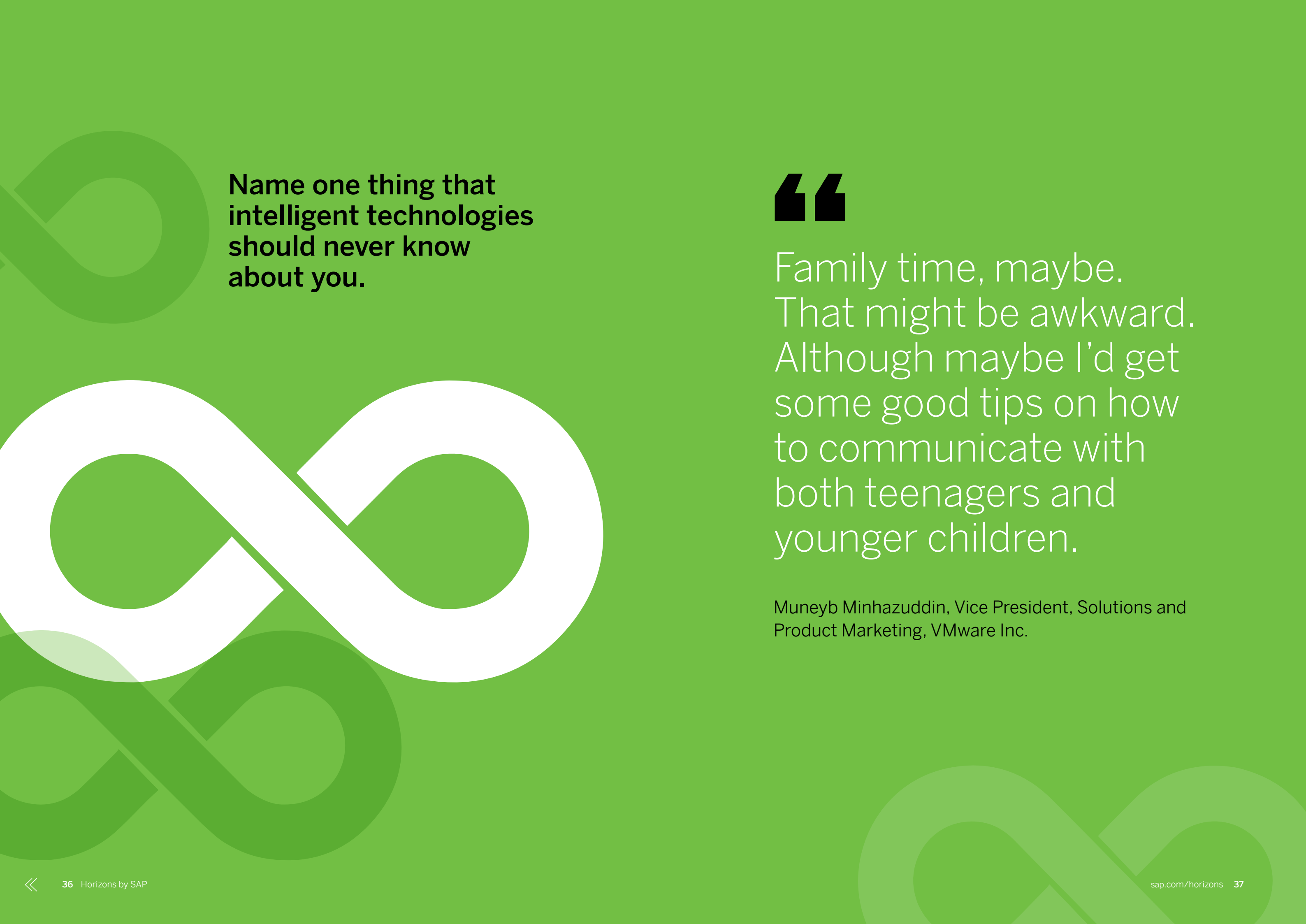
### User Experience Benefits

End users get a uniform workflow experience, no matter which device or operating system they choose. Single sign-on and a wide selection of productivity tools allow employees to work smarter, thanks to contextualized workflows that make it easy for applications to share information. At VMware, integration between our meeting, scheduling, and navigation software helps me move quickly and efficiently from one meeting room to another on our 100-acre campus.

The technology has also helped me streamline employee approvals for members of my team. Intelligent workflows consolidate all of my approvals and let me approve or decline a request from one location. Together, these intelligent applications reduce complexity and save me about one day of every workweek. That's value that no enterprise wants to live without.

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VMware developed the same kind of abstraction layer for the application deployment that we created two decades ago for hardware and data centers.  
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**Name one thing that  
intelligent technologies  
should never know  
about you.**

“

Family time, maybe.  
That might be awkward.  
Although maybe I'd get  
some good tips on how  
to communicate with  
both teenagers and  
younger children.

Muneyb Minhazuddin, Vice President, Solutions and  
Product Marketing, VMware Inc.

An aerial photograph of a city plaza with a grid of lines on the pavement. Several people are walking in different directions. A large, semi-transparent blue arrow graphic points from the top-left towards the bottom-right, overlapping the plaza image.

# Developing Genuine Workplace Intelligence

Technology Guides  
Employees to Work  
More Productively

Innovative tools use data-driven insights to improve the employee experience while also supporting desired business outcomes. Will the value it delivers help people learn to trust the technology?



Just like people, organizations can have intelligence too. “Workplace intelligence” describes things like culture, climate, leadership, and employee engagement that create a great place to work – and deliver positive business outcomes. Horizons by SAP talked with [Ryan Fuller, corporate vice president of workplace intelligence for Microsoft Corporation](#), about the meaning of workplace intelligence, the technology tools needed to develop it, and the trick to using data-driven insights securely and with trust.

**Horizons:** The term “workplace intelligence” is relatively new. How would you define it?

**Ryan Fuller:** Overall, it’s about working smarter, not harder, but not just at an individual level. We want to find ways to make the whole organization work smarter. It’s often not clear how to do that, because it’s hard to understand how the things hundreds or thousands of employees do each day add up to the results that companies actually measure.

**Horizons:** How do you get a clear picture of what’s happening?

**Fuller:** You need to be able to zoom way out to be able to see the whole picture. That requires the right kind of data, so you can identify the patterns that lead to better outcomes. Often companies spend huge amounts of time doing things that don’t add that much value. How can we stop doing those things and devote the time to more impactful things? Or give our employees more of their time back, so they can live fuller lives beyond work?

**Horizons:** The idea of continuous improvement has been around for a long time. Yet in many organizations, it feels like we’re going in the wrong direction.

**Fuller:** [Workplace intelligence helps us create some new patterns that reverse that trajectory. It gives everybody the tools, visibility, and data to know how to work as effectively as possible in the shortest amount of time possible.](#)

**Horizons:** What is the first place to start experimenting, once you’ve freed up some capacity?

**Fuller:** We like to look for bright spots – those parts of the team or organization that consistently outperform their peers. Oftentimes, leaders know that a given team is great, but don’t know why. Usually the team doesn’t know either – they just know that they do good work.

**Horizons:** How do you figure it out?

**Fuller:** When we focus on the behavioral data, we can start to see patterns. Let’s say you learn that the team spends 50% more time with customers than any other team. You then learn that happened when their management decided to spend less time on forecasting and internal processes. Although it’s a simple change, it’s massively impactful in terms of how people have been able to spend their time. And now you have a proven pattern within your own organization that you can scale.

**Horizons:** Success breeds success.

**Fuller:** Exactly. If you can find areas that are working, you can then figure out why and how it happened and scale it out. Next, you must spot opportunities to improve and enact those changes elsewhere. [Companies get into this continuous cycle where people identify opportunities, use data to figure out a better path forward, and then enact change programs. Then they measure results.](#) The idea is to encourage a culture of experimentation and learning.

**Horizons:** What kinds of capabilities or functionality are needed to execute this type of program?

**Fuller:** My team specializes in compiling passive, aggregated, and deidentified data automatically generated from e-mails, meetings, chats – all kinds of collaboration tools that companies use. We turn that data into a behavioral data set. From that data, you can understand how people spend time, which teams are spending time with other teams, and what people’s networks look like. You can derive all of these very interesting insights that are really hard to measure in any other way. As a result, company leaders can get a full understanding of exactly how that process works. They can tell whether it is efficient or needs to be improved.



Often, companies spend huge amounts of time doing things that don’t add that much value. How can we stop doing those things and devote the time to more impactful things?



**Ryan Fuller**, Corporate Vice President, Microsoft Corporation

**Horizons:** In your research and your work with customers, have the analytics revealed any surprises?

**Fuller:** Very frequently, actually. For example, sales leaders often say that sellers should spend most of their time with customers. We can look at the data to see how teams are working, how they engage with customers, how much time they spend on different activities, who they bring to the meeting, and what their networks are like. You can also see which patterns correlate most with revenue generation. And top performers do tend to spend more time with customers. But even more predictive of better performance is that top performers have larger internal networks – meaning that they engage with more people within their own company more frequently than others do.

**Horizons:** Why is that?

**Fuller:** When you think about it, sales is not a one-person activity. For example, you must know the right specialist to bring into a customer meeting, or the person in legal that can push through a contract quickly, or how your product team is thinking about the road map. In fact, your ability to bring everything that your company can offer to a customer is really contingent upon your personal network. That takes work and a lot of time. If you spend 90% of your time with customers, how are you going to know anybody at your company?

**Horizons:** So, how do people react when they get these insights?

**Fuller:** Sales leaders initially find it counterintuitive that internal network is so important. Once they see the data, they can quantify how that networking accelerates the ability to produce revenue. Then they understand the value of this intelligence.

**Horizons:** What kind of tools are available to help companies develop more workplace intelligence?

**Fuller:** It starts with identifying new insights from a behavioral data set. That's what Microsoft Workplace Analytics offers. Instead of relying on surveys, anecdotes, and consultants to know what's happening,

the technology provides an objective, always-current data set. You can set new goals for what you want to achieve and then operationalize it by putting in place some lever to drive change.

**Horizons:** How would that look in your sales example?

**Fuller:** Management could decide that employees need time to develop those personal networks. Perhaps they redesign sales territories to make them smaller. Then we measure to see if that has an impact. The data helps you know when to make a change. And then you can operationalize it using traditional management levers, like a dashboard.

**Horizons:** Where do the employees' decisions come into play?

**Fuller:** The next layer is addressed by products such as Microsoft MyAnalytics. Let's say you realize that teams with higher employee satisfaction have managers who spend more time in one-on-one meetings with their direct reports. This context-aware technology provides employees with individualized, personal insights that help them accomplish their goals. Maybe a calendar app sends a message suggesting that a meeting with your direct report Brian is overdue, and it notes that you're both free tomorrow at 2:30. The software prompts you to send a meeting invitation. We try to engage users at just the right moment with helpful information that will help them be more productive and engaged.

**Horizons:** What different types of assistance can employees benefit from?

**Fuller:** Some solutions make it easier for a user to do something they already intended to do, like automatically filling in the rest of an e-mail address as they type. More advanced software proposes things that the user didn't think about but would have done, like scheduling that meeting with Brian. The most sophisticated is software that introduces actions the user wouldn't have considered, because they are designed to meet some larger organizational goal.

**Horizons:** You mentioned security and trust earlier. How do you find that balance between providing useful insights and maintaining employees' trust?

**Fuller:** First, flexible privacy and compliance controls allow customers to protect their data. Organizational data is aggregated and deidentified. It's adapted to country requirements. And the tools evolve based on what customers need. We do a lot of low-scale experimentation and we work hard to solicit feedback on how people are using the software and their reactions. We frequently change the words we use on prompts. It's amazing how the same nudge, worded slightly differently, can be received differently.

**Horizons:** There's a real risk-reward equation that people apply to technology.

**Fuller:** That's true. **People may inherently distrust the technology, but they start to feel differently if they're getting value from it.** That said, we need to earn trust by making sure that we're not doing any of the things that people worry about. As we earn trust, hesitancy shrinks. But that's not something you can do overnight. We think about it every day, with every feature. Because we know crossing that line is not easy to uncross. We want to help organizations and employees be empowered to spend time in the most useful ways, and as we do that, the value grows and grows.



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The technology provides an objective, always-current data set.  
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**If you were stuck on an island and could bring only one smart device, what would it be and why?**

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If I'm stuck on an island, I probably don't care about most of the things I use my smart device for. Maybe I'd bring a Kindle with a bunch of books.

Ryan Fuller, Corporate Vice President,  
Microsoft Corporation

Mining  
User Behavior  
to Deliver a  
Better  
Experience



By **Torsten Zube**, Vice President, Head of SAP Cloud Platform Business Services, SAP SE

# Understanding What Users Really Want

Knowing how people really use a software application can provide the insight needed to change things to their liking – if it can be done without violating their data privacy.

Software companies work hard to learn what users want so they can deliver an excellent user experience. We research their preferences, collaborate with them to design applications, and ask for their feedback on products. Even so, do we really know enough about how people use our software?

Years ago, when I worked as a software developer, I had the opportunity to find out. As I watched from behind a one-way mirror, a highly satisfied customer sat down at the computer and used the application I'd helped create. What I saw shocked me. Our customer was interacting with the user interface in a completely

different way than I'd intended. He used only about 30% of the features I'd designed – and he used those inefficiently.

Clearly, we didn't have enough insight into the user experience to improve it. We had designed business processes and incorporated them into the software. Our customers changed their internal processes to meet our standards. Although we refined the user interface over time to become more friendly and intuitive, we never knew how users really worked within the software.



## User Behavior Mining, Defined

To deliver the best user experience, enterprise software must meet three needs.



First, it must **recognize the user**, the way my cell phone does when I tap the screen or press the home button. In real life, we trust people we know and that knowledge tells us how we want to behave or react to them.



Second, the software must **understand the user**. Think about your personal relationships. The longer you've known someone, the easier it can be to sense a behavior or a need. Sometimes a certain look alone is enough to convey what someone is thinking. Software should be able to pick up on equivalent cues based on the longevity of experience serving a particular user.



Third, applications should be able to **predict what the user wants to do next**. Some software uses learned insights to anticipate user needs. But most of those features are based on a cluster of users, not an individual enterprise worker.

Experience management solutions offer a good starting point for collecting this information. These solutions allow developers to ask users how they feel about the software and collect sentiment data that helps vendors improve the user experience.

But we need to take this effort a step further. What if software could sense a person, understanding a user's activity or intentions without having to ask those questions? Instead of predicting the types of questions we would like to ask the user and then expecting the user to respond to those prompts, we could just measure what the user is doing at various points during the software interaction.

**That's how user behavior mining works. Software tracks the interaction between the user and the application interface. After capturing that data, it analyzes or "mines" it to determine how each person uses the software.** We can map the captured interactions to the business objects to understand how a business process is executed through the user interface.

The insight delivered by this analysis can help us predict which steps the user might take next. It also highlights any tasks that are difficult to perform and provides guidance on whether the user interface should be modified to create a better experience.

For example, imagine a user who creates 20 or 30 product orders per day. If the user repeatedly changes the year value for each order, user behavior mining would indicate this and trigger the system to predefine the year value for this user. The application could also learn that this user never uses certain fields and it could hide those fields on the user's display to reduce the complexity.

## Deeper User Knowledge

User behavior mining offers tremendous potential. Current technology allows us to understand where a user clicks, but we don't yet know the meaning of those clicks – or the overall interaction path.

We know that the way software developers design processes and the way people use them is quite different. **If we can capture the behavior and then use tools to translate that data into understanding, we could intuit what a user wants to do.** We can develop software that matches user needs and automatically delivers a customized user experience – absent any bias from the software vendor about the "right" way to perform a task.

Innovative technology can help. For example, what if we include biometrics in user behavior mining? Whether we use a camera, motion tracking, or a sensor measuring the user's blood pressure, the interface between human and machine could be eye-opening. Not only could we track where a user clicks within the software, but we could also correlate those clicks with user stress levels.

This insight could help us learn whether the application actually serves the process preferred by the user or if the user has just developed a work-around to use the software. Perhaps the way the user is doing the task is actually cumbersome, but the software offers no better way to do it.

That's not something that users often tell us. Sometimes they think it's not an issue worth raising with the vendor. Often they just make adjustments and keep using the software. If we could use tools to sense how users feel, we could identify problems and refine processes to better them.

Although user behavior mining is still in its earliest stages, our group focused on new ventures and technologies is already working with it in productive use cases. The Spotlight by SAP solution analyzes system usage logs in just a few minutes – with no installation or implementation required. It then calculates the amount of effort required to perform any business processes running through an SAP solution, identifying candidates

for automation. By augmenting back-end data with data collected through user behavior mining, the solution will eventually provide insight into the user journey through the application.

## Data Privacy Challenges Ahead

One important consideration in the application of user behavior mining is the issue of data privacy. Obviously, the data we collect is very personal and must be protected. At SAP, we anonymize all user data immediately upon collection. The software clusters data into patterns that are not user-specific.

For our early use cases, this form of data anonymization works well. As the software becomes more able to personalize its approach to unique users, we may need to focus more on the nonanonymized data of individual users. **It's not clear yet how software vendors can strike a balance between personalized offerings and data privacy.**

I do know one thing, however. We need to deal with the human ethics around this from the very beginning – not after a problem arises and we are sitting in a lawyer's office. We must understand which behaviors act in favor of humans. It's not enough to approach this strictly from the technology perspective.

There is no one right answer when it comes to ethics. With technology, there is always a trade-off between what you give and what you get. If I use Web mapping services, for example, I gain location intelligence and targeted advertising, but I pay with data about my behavior. We all know this. As humans, we can decide whether we are ready to share data about ourselves.

Vendors also have a choice: we can hide this reality about data privacy or we can be fully transparent. My recommendation is that we should be completely transparent about which data we collect, what we do with the data, and how we treat the data. If we are open about what we are doing, people will trust us to make good decisions on their behalf, without misusing their data or taking advantage of it. Creating an exceptional user experience is valuable, but only if users remain in control of their data.



# On Your Technology Radar

## Explainable AI

As we augment capabilities and expand our reliance on algorithms deeper and deeper in our enterprise systems, understanding how machines learn and which factors influenced the AI decision is critical not only for regulatory compliance but also for user trust.

## Machine learning on personal data

Ensuring personal data is protected even as it's used for machine learning is fundamental to building intelligent services. Approaches like differential privacy and fully homomorphic encryption may help us preserve privacy and utility for machine learning.

## Natural-language understanding as a foundation for intelligent machines

Adept communicators can detect contextual clues from even the smallest conversational elements, such as word choice. These same signals can, should, and will be trained into our natural-language systems to better understand and react to our needs.

## Privacy first

Consumer applications are daily proof that we are willing to share our information – as long as the value exchange is clear. Privacy is more about control than secrecy. Look to tools like self-sovereign identity to empower us to easily manage what we share and with whom, so we can confidently enjoy all the benefits of contextually aware systems.

## Knowledge graphs and graph analytics

Context is formed by understanding the interplay between parties. With graph-based data structures, we can model relationships within data and develop reasoning to help us understand the meaning of different entities and their associations.

## Ubiquitous assistants

IT systems are increasing in complexity, but user interfaces must do the opposite. On the journey to perfect context, digital assistants can help us navigate systems and collect our feedback to improve the imperfect anticipation of our needs.

## Biometrics

We voluntarily use devices that track our physical movements, biometric indicators, and vital signs to manage our health, support easy authentication, and personalize our experiences. The technology to bring this into the enterprise is widely available. We can bridge the gap between humans and machines, as long as we demonstrate value for users.

## Enterprise applications in the spectrum of cloud, fog, and edge

More and more machine data is being collected and consumed at the edge to ensure ultra-low latency and strict privacy. To provide the optimal data processing needed to create contextual awareness, we need to automatically and dynamically manage software components in the network.

## Cross-company processes and data

Building contextual awareness across systems and applications shouldn't stop at your company borders. Blockchain could be the backbone of automated, multiparty business processes, while simultaneously reducing needless data replication.



# Doing the Right Thing

Ethical  
Considerations  
in the Era of  
Enterprise  
Intelligence



By **Christoph Lütge**, Director of the Institute for Ethics in Artificial Intelligence, Technical University of Munich

Companies love the efficiencies and insights yielded when they embed AI and other intelligent technologies into their business processes. But, unless someone takes steps to ensure that technologies are ethically positive, the risks may outweigh any rewards.

When we speak of ethics, most people think about the moral principles that govern the behavior of individuals or organizations. Ethics can seem highly abstract, a subject more useful to ancient philosophers than modern business and technology leaders.

Yet ethics is an important issue for today's decision-makers – one that must be handled with extreme care. The rampant growth of artificial intelligence and other intelligent technologies in businesses makes ethics more than a philosophical question. **Ethics is now a form of risk management that savvy businesses cannot ignore.**

Look no further than the news to see how ethical scandals and problems can become a heavy economic burden for affected companies. Enterprises such as Enron, Siemens, and Volkswagen learned the hard way that poor ethics can negatively affect the bottom line. Beyond the fines were reputational damage, lower sales, and, in some cases, bankruptcy.

By properly managing ethical risks, companies can improve their overall risk management. Like most operational issues of this magnitude, however, it is not a task that can be the sole responsibility of individuals. Although you might want “honest” employees in your organization, that's not enough. Ethics and integrity must be hardwired into your organization. Enterprises must develop organizational guidelines and standards that lay out in fine detail which behaviors are desired and encouraged and which are unacceptable – or even grounds for dismissal and potential legal action.

### Balanced Perspective

With intelligent technologies such as AI embedded in business processes, the types of ethical risk grow. We know from surveys and other forms of social sentiment that people are skeptical about the use of these technologies. They wonder whether algorithms have been programmed to reflect inherent biases, and they worry about issues such as data privacy, security, and hackers.

The technology itself is something of a black box to most people – even those who are highly technical. Our institute has seen many cases where the results of AI processes are not always intelligible, even to their programmers. And most executives have little to no knowledge of AI ethics.

To address these knowledge gaps, experts have developed a number of high-level, abstract principles for AI ethics. **Although these efforts are quite valuable, it's time for enterprises to adopt more concrete guidance. We need to share the details of how these technologies work – and affect enterprise ethics – with engineers, programmers, and businesspeople.**

In the research groups at our Institute for Ethics in Artificial Intelligence, we always include representatives from the technical side and the ethics or social science side to work together on creating tangible, actionable ethical guidelines for certain AI systems – such as those that might be used in the financial sector or healthcare.

Many executives have asked what they need to do to ensure that ethics are appropriately considered in their organizations. They want to know whether they should create new departments or positions that would be responsible for ethics. It's difficult to know the correct answer for every enterprise.

Most importantly, enterprises must focus on integrating ethics into their AI development teams. After that, it may be helpful to have new people or new competencies that can work with developers to better understand the ethical impacts of technologies like AI.

### Opportunities Ahead

As intelligent systems begin to deliver more detailed information faster than ever, work will change for employees. AI promises to accelerate many processes, even while processing larger volumes of data. With these new efficiencies, workers will spend less time assessing information and more time taking action.

The technology may lead to reductions in staffing for some corporate functions. For example, companies in industries such as insurance or banking may require fewer analysts. This does not mean that there will be a time when there is no work left for humans to do, however.



Instead, there will be an increased focus on the interfaces between workers and AI systems. Our institute has assigned a research group to work on this topic because we feel it will become increasingly important. Often AI systems do not sufficiently consider the preferences of workers who are collaborating with the technology. Developers must design intelligent technologies that can adapt more flexibly to what people want and need.

Communication interfaces present another challenge for AI and employee interaction. In the healthcare sector, for example, how should the technology communicate patient results in a way that supports the organization's ethical standards? In HR, some companies are already using AI technologies to assess the résumés of job applicants and reduce the pool of people to be interviewed.

**These applications present certain ethical risks – but there are also opportunities.** For example, although we know that autonomous driving applications come with dangers, it's not often acknowledged that they can be programmed to significantly reduce the number of accidents and the damage to people and property as compared with human drivers. That's an ethical goal we can achieve through technology.

In healthcare, the introduction of new technologies can save lives and reduce suffering. Telemedicine and robotic surgeries are two examples of how the practice of medicine can be made more ethically positive. Humans make many errors because they rely on gut feelings or indulge in irrational behavior. In some areas, AI could equip us to make better decisions and take steps that would help people – if we embed the right ethical rules.

### Ethical by Design

Technology that is ethically positive by design is an evolving concept. We need to build ethics into the code, and that's doable. But there are other aspects that should be considered. In machine learning, for example, we need to consider how training data is selected.

There have been many examples of AI that was biased because a company used only the data already collected. We can correct this by developing more sensitivity to this issue. Some applications may need to add more data. Or they could include some kind of artificial data on which to train algorithms. This is something that will be a huge issue for companies in the future.

In addition, the responsibility for ensuring that information is accurate, current, and well-governed is shifting. In many parts of the world, laws hold individual drivers responsible when a vehicle crashes. That will have to change. If the vehicle is autonomous, the driver is no longer responsible – the vehicle manufacturer or software vendor is.

From the worker perspective, the technology and the data also must be trustworthy, which can happen only when the right interfaces are designed between humans and technology. When people are faced with a kind of black box that delivers output, it does not engender essential trust. Think of the drivers who receive but then ignore directions from a GPS because they assume they know their roads better. **As a general rule, the system is better informed. But you have to trust it first to realize the anticipated value.**

Regulatory frameworks may help us make the transition to more ethically positive and humane intelligent technologies – but those will happen on different timelines for different applications. For autonomous driving, there are already some well-crafted proposals for regulation. In other cases, such as financial services and healthcare, we need more work before we can create useful regulations.

But we need to be careful not to put the technology at risk with regulations that are too strict or too early. Ethics can help industries develop the right rules at the appropriate time. Groups such as the International Telecommunications Union, a specialized agency of the United Nations, are already working on international standards for AI, creating a foundation for building these new technologies.

To deliver the desired results, intelligent technologies need to consider the human implications of their use. As I like to tell my students, "AI cannot fly without ethics." As business and technology leaders recognize this truth, they can begin to address ethical issues from the start of their technology initiatives – reducing the risk of later problems.

### Training Students for Ethical AI

Developers need to better understand the cultural and social aspects of their work in order to ensure that it supports desired enterprise ethics. One way to make this happen is to ensure that engineering and business informatics students receive education about these areas as part of their curriculum.

To meet this goal, the Institute for Ethics in Artificial Intelligence at the Technical University of Munich is partnering with the Institute of Electrical and Electronics Engineers to develop ethics and social science education for the engineering and computer science curricula. The university has previous experience merging ethics education with science programs. In 2013, the school introduced ethics into its management curriculum, which has been a tremendous success. Our overarching vision, which is to create "human-centered engineers," is one that we plan to work on in the coming years.

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AI cannot fly  
without ethics.  
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**Name one thing that  
intelligent technologies  
should never do for you.**

“

Here in Munich, we have many excellent Italian restaurants. I'd like my espresso to be made by a barista instead of an intelligent machine.

Christoph Lütge, Director of the Institute for Ethics in Artificial Intelligence, Technical University of Munich



# It's Personal

Ensure Data  
Privacy While  
Unlocking  
Business  
Insights



By **Dimitri Sirota**, CEO, BigID Inc.

## New regulations require enterprises to protect users' personal information. How can companies convert this compliance mandate into real business opportunity?

In the good old days – let's say, 10 years ago – data protection was synonymous with technologies such as encryption and tokenization. By transforming the data or making it less visible, companies were able to protect their data and that of their customers. No more.

Times have changed, and with them, so has the approach to data privacy. New regulations pivot on the notion that data belongs to individuals, not the enterprises that collect it. Instead of just masking or hiding the data, companies need to provide fundamental data accountability to their employees and customers.

But how can enterprises be accountable for data when they don't know what they have, where it is, who it belongs to, where it's been, or where it's going? To meet today's mandates and user expectations, companies need to completely rethink data protection.

### Personal Information, Defined

Data privacy is a game changer. Until recently, though, it was very low on the list of enterprise priorities – even for chief information security officers, CIOs, and board members.

The breach regulations that were introduced over a decade ago were based on the idea of protecting personally identifiable information (PII). PII is defined as highly identifiable information and data that can be uniquely correlated with an individual, such as a Social Security number or a credit card number.

**Data privacy is different. It requires companies to take responsibility for the collection of data that belongs to an individual – a concept known as personal information (PI).**

The trouble is that PI is not necessarily highly identifiable. Here's an example: a birthdate is one date in the 365-day calendar. That's not highly identifiable. A GPS location is a point on the globe. Again, not highly identifiable. An eight-digit string of numbers could refer to many things.

But when these bits of data are in a different context, they can be highly personal and thus qualify as PI. If the birthdate is mine, or the GPS location was collected as part of my mobile session, or if the string of digits is my password to an application, it's all highly personal and highly confidential. When data such as an IP address, cookie, session key, date, gender, birthdate, password, or location is about me, that is PI.

### Preliminary Data Identification Processes

New privacy regulations require companies to find and protect PI. The European Union's General Data Protection Regulation (GDPR), implemented in May 2018, and the California Consumer Privacy Act (CCPA), which came into effect January 1, 2020, are two high-profile examples of PI legislation. More than 20 other U.S. states have privacy-related draft bills and there is talk of a federal law.

With this legislative push, companies can no longer ignore the need to protect data privacy. Decision-makers need to get acquainted with the implications of these laws and identify compliance gaps.

Most organizations begin by revising their data identification and classification processes. They look for ways to find and identify data manually, because that seems like the simplest approach. Then they implement policies to reduce the scope of things that fall under their responsibility. The majority of companies are still at this point in the data privacy process.



Before long, however, organizations realize that the ROI is so unattractive and the accuracy of these processes is so poor that they need to replace manual efforts with automated approaches.

**The only way to identify PI is to use context to determine whether data is personal. That requires a completely new way to examine and assess data. That's where innovative new technologies come in.**

### Context-Sensitive Technologies

New purpose-built PI technologies address these privacy-centric data discovery and data intelligence use cases. The solutions bring data science, machine learning, and advanced data insight to the challenges of data privacy, helping enterprises safeguard and steward data by finding it and learning its context. The solutions also help companies track and govern their customer data at scale, which is important when dealing with huge and growing volumes of data.

New enterprise data intelligence technologies work with different IT systems, applications, and products – on-premise or in the cloud – to discover PI. Using context, it automatically finds hidden information and relationships among data to identify PI and inventory it by data subject and residency. Advanced solutions use dozens of parameters to score the data and then build a map of the data and its flows, which is especially important for tracking ephemeral data assets.

This data privacy technology is basically the IT version of accounting standards like GAAP. Before GAAP, there was no standardized way of tracking deposits and withdrawals in financial institutions. The introduction of standards helped banks identify funds and report information in a standard way – allowing any analyst or observer to understand the health of the business.

“How can enterprises be accountable for data when they don't know what they have, where it is, who it belongs to, where it's been, or where it's going?”

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## Data Is the New Oil. Or Is It?

It's become commonplace to say that "data is the new oil." And while data and oil both offer value to enterprises, there is a difference. Oil is fungible. One barrel of oil is essentially the same as another, no matter its source or destination.

Data is distinct. There may be similarities, but one person's data is not the same as another's. Data has a profile. It has a fingerprint. It belongs to someone. For that reason, data is harder to account for than oil. And enterprises need to account for the data they possess, down to the individual.

With data, organizations traditionally collected information from individuals, but what happened to it afterwards was unclear. With no GAAP-like standards, it was up to the enterprise to determine how or whether the data was protected, tracked, or reported.

Now people say that "data is the new oil," or "data is the new currency of the digital enterprise" (see sidebar). New data privacy regulations recognize data's increasing importance. But they also demand that organizations reconsider data and how they protect it.

To be compliant, companies must know where they got their data, who can access that data, and whose data they have. They need insight into where they stored the data and who they shared it with. And if they are sharing data, enterprises need to know why they are sharing it and whether they have the permission of the data owners to do so. The answers to these questions not only help companies meet these compliance requirements but also get a handle on their most important assets.

## Opportunity for New Business Value

The way enterprises understand, process, and protect their data influences the type of consent management functionality they offer users. Until recently, gaining user consent was a matter of asking users – repeatedly – to agree to allow their data to be collected and used. These repetitive pop-ups and interruptions can be overwhelming for users.

Fortunately, regulations like CCPA make it easier for users to opt out of data collection by inverting the power dynamic. Instead of a long series of radio buttons requesting unlimited rights to data, new consent management features allow individuals to quickly and easily refuse to allow organizations to resell or reuse their data. The responsibility then falls to each enterprise to ensure there is no violation of the user's opt-out request.

Yet meeting this challenge requires companies to gain more granular insight than has been available previously. Enterprises need to know where all of a person's data is throughout the data lifecycle – whether it resides in files, data warehouses, data lakes, business solutions, mail applications, or messaging apps, to name just a few possibilities. Then they need to be able to disambiguate the information, knowing when an eight-digit numeric string is just a sequence of numbers and when it is a password. Also important is the ability to find contextual PI and connect it to an individual, which requires understanding of data both at a single point in time and as it evolves over time.

All of this information is critical to meeting new PI compliance requirements. More importantly, it can help companies get more value from their data assets. **With the proper context, organizations can know where customer data is – across multiple countries, languages, and businesses. Essentially, they'll have a much richer understanding of the crown jewels of the organization.**

With that understanding, not only is there an opportunity to do better – in terms of revenue and profitability – but enterprises can more effectively protect their assets. Context-enabled insight allows companies to reduce data duplicates and rationalize the infrastructure needed to support the data. It also helps identify the right time to consolidate servers or migrate data to the cloud.

What's more, a complete inventory of the data can help companies identify potential vulnerabilities, areas of exposure, and potential for non-compliance. They can also better safeguard data, get more value from it, and reduce overall costs. And that's value that today's businesses cannot resist.

**If you were stuck on a deserted island with just one smart device, what would it be?**

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If I had wireless coverage – which of course means I could probably call for help – I would take my phone. The thought of being without a phone these days is so dispiriting, like being in solitary confinement in a prison cell.

Dimitri Sirota, CEO, BigID Inc.

# Bend, Don't Break

Supporting  
Innovative  
Business  
Models with  
Software-Defined  
Networking





By **Debika Bhattacharya**, Vice President, Global Solutions, Verizon Business Group, Verizon Communications Inc.

## Say goodbye to static networking infrastructures. Today's networks are software-based – offering unprecedented flexibility and scalability.

Traditional networks were once the skeletal foundations of our IT infrastructures. Comprised primarily of hardware, these static networks required physical effort and manual intervention to make significant changes.

Innovations such as data center virtualization and cloud computing relieved some of the burden created by these older networking technologies. But now a new technology, software-defined networks (SDNs), is simplifying and streamlining networking.

**SDN technology abstracts the network functionality, separating it from physical hardware – and decoupling the data plane from the control plane.** Enterprises can use the centralized control plane to make decisions and set policies, and they can do it at scale. The hardware acts as the data plane that responds to any changes made to the control plane. By making the infrastructure more elastic, SDNs help companies gain new agility and flexibility in their networks.

SDN can also virtualize network functions, relieving the need for purpose-built hardware. In the past, companies purchased different devices needed to deliver networking functionality – routers, switches, firewalls, load balancers, and the like. With SDN, the network is now software-based, so these functions can be delivered virtually. You can also use software to increase capacity or introduce new functionality.

This software-based technology improves network agility and flexibility. If you need another router to meet today's traffic demand, you can create one virtually. If you don't need it tomorrow, you can remove it. Enterprises can rapidly respond to changes in market demand or customer requirements. SDN supports innovation in a way that static networks cannot.

The possibilities for SDN technology range from simple additions to an existing network to more complex configurations and new architectures. Many companies begin by adding intelligent, application-aware routing, followed by network function virtualization, automation features, and network self-healing capabilities.

### Advanced SDN Capabilities

In the past, networks did not differentiate between applications and handled them all equally. Today's enterprises have hundreds or thousands of applications. Some are more critical than others to the success of the business.

Perhaps a videoconferencing application is exceptionally important to C-level executives. Maybe finance needs the highest possible throughput each month when closing the books. Or a manufacturer wants instant insight into customer demand or supplier commitments, especially in advance of peak sales periods.

**SDN technology allows you to prioritize and differentiate each application.**

In addition, SDN technology allows you to ensure consistent, predictable application performance – regardless of geography or user demand. Important applications are given high priority. When demand is high, the technology moves less critical programs to alternate paths. As a result, users always get the desired application experience.

Network telemetry offers real-time insights into how the network is performing, so applications can more intelligently use available resources. This prevents organizations from overbuilding capacity and helps companies maximize the value of their current IT in order to ensure optimal performance of the network.

Programmable SDNs offer automation tools you can use to change policies. IT administrators can make an adjustment – for example, increasing throughput for a customer-facing medication ordering Web site during a pandemic. When an administrator changes the policy at the central location, the SDN technology uses orchestration to populate the change automatically throughout the network.

Administrators can also define – with far more granularity and at scale – network service levels received by different users and user groups. With this contextual awareness, networks can be programmed to provide the highest quality service to certain applications, organizational VIPs, or user groups – consistently and specifically as needed.

In truth, IT administrators could have made these changes before SDN. But the manual effort would have been time-consuming. And changes could not be made at scale. **With today's SDN technology, administrators can change performance levels, evaluate new network data, and change them back again – quickly and with minimal effort.**

Context-aware SDN technologies can also help network administrators respond to new demands, such as a change in data traffic patterns. In case of merger or acquisition activity, you can use SDN technology to integrate with the new organization's network. During the recent Covid-19 pandemic, organizations who had deployed SDN have been able to quickly adjust to new traffic patterns and network requirements resulting from work-from-home mandates. Because the network layer is programmable, administrators can make changes within hours. And automated SDN technologies can execute the revisions in moments, without any manual intervention.

### The Role of 5G

5G networking technology is intrinsically connected with SDN technology. Verizon is using millimeter wave technology for our 5G network, which is tailor-made for applications that require more and more bandwidth. We've been building our own SDNs for years to enable the ultrawideband 5G networks we are deploying. SDN technology gives us the flexibility to quickly repurpose 10 GB to 100 GB of bandwidth to cell towers as traffic patterns change.

**Combining 5G with a mobile edge compute (MEC) platform takes SDN technology to the next level.** MEC combines an ultrawideband network with cloud services to allow enterprises to develop large-scale, latency-sensitive applications at the edge. It also puts compute power closer to the end user and allows applications to respond much more quickly, often in near-real time.

In a mature SDN environment where automation is deployed, SDN technology running on 5G and MEC can help you make decisions quickly. Picture a manufacturing company that employs cognitive video of the shop floor. SDN allows operators to see a product defect and take action quickly – such as shutting down an assembly line. The elastic environment includes automation that reacts to environmental changes and makes decisions, with learning capabilities that change the application or fix whatever is broken, all in near-real time.

### Automated Improvement

**One of the most satisfying parts of my job is seeing how clients deploy SDN technologies to create a platform for innovation.** For example, one retail company is now better able to adjust to unpredictable demand.

Traditionally, in a demand spike, sales rise for specific items and personnel check the warehouse for more inventory. If inventory is not in the warehouse, they might contact supply chain partners to see when a new shipment could be sent, making a lag in product stocking common.

SDN-enabled technology, coupled with integrated inventory management, has considerably shortened restocking intervals. Without human intervention, the application requests shipments of the product to the store. If the demand is high in other locations, the application takes steps to make sure inventory is replenished where it is needed.

These functions are built into the process workflow. SDN can even touch the logistics process, sending instructions on which products to load onto the delivery trucks. With this automated dissemination of knowledge, the supply chain can be significantly shortened, perhaps by days or even hours. Retailers can better respond to demand spikes, keeping shelves stocked. Thanks to SDN, integrated applications, and automation, retailers can pride themselves on having the inventory they need.

### Risks and Rewards

Deploying SDN is not without risks.

As with any new technology, misconfiguration is possible for those who pursue complex deployments without adequate training. While SDN offers benefits that may encourage some enterprises to be reactive and take quick action, they must consider second-order and third-order consequences of their changes. We tell our clients to deploy SDN in an intentional way. Companies must look beyond a technology-only focus and think about the end-to-end workflow that SDN may provide for them.

Now that the network is essentially software-based, care must be taken to protect dynamic and evolving threat surfaces. It's important to embed a zero-trust security model into the architecture from day one, rather than bolting it on later.

Expert services can help companies ensure they avoid common pitfalls. I tell clients: **Do your homework. Test the technology and examine end-to-end process workflows. Don't just follow the hype.**

Professional services can be a good investment, helping you through the selection, implementation, and tuning processes. Choose experienced providers, who can give you the expertise needed to integrate SDN technology with the applications for maximum benefit. Although you may be able to make SDN work, without expertise you won't realize the full potential of the technology.



By making the infrastructure more elastic, SDNs help companies gain new agility and flexibility in their networks.



### Getting Started

The following questions can help you choose the right SDN technology options.

**Are current network function capabilities built into the SDN technology? Are they extensible?**


Common networking technologies may be virtualized today and are highly effective. However, the benefit of SDN is that it allows you to future-proof your infrastructure. You should plan on investing in solutions that are built to accommodate future needs. Look for extensible technology that allows you to add functionality as your deployment matures and your requirements change.

**Will the SDN technology help solve for the unknown?**

Yes. You don't want to replace one set of limited capabilities with another. Think about where your business is heading and which changes may happen in the future. Look for SDN solutions that will allow you to add the types of services that you may not necessarily need today.

**Can the solution support exponential thinking?**

Absolutely. With SDN, there is great opportunity for innovation. Think about how SDN can help you write applications differently. How could your business benefit if the application could speak to or respond to the network directly? What if you could rapidly create or change services based on market demand? This is the kind of innovation that can help your company differentiate itself from the competition. It will also better prepare you to respond quickly to potential interruptions to business continuity.



**Name one thing that  
intelligent technologies  
should never know  
about you.**

“

I'm a fashion magazine addict, and I would rather not share the number of hours I spend looking at expensive dresses, bags, and shoes!

Debika Bhattacharya, Vice President, Global Solutions,  
Verizon Business Group, Verizon Communications Inc.



# Building Better Software

Embedded  
Context  
Awareness  
Differentiates  
Solutions and  
Improves User  
Experiences





By **Graham Ratcliffe**, Head of SAP.iO Venture Studio, SAP SE

## Get ready for software that understands how, where, and when it is used. What should you know to build context awareness into your solutions?

When startups and development organizations create software, differentiation is everything. Products that set themselves apart from the competition – by offering enhanced functionality or a better user experience, for example – are more likely to win over decision-makers. **Adding context awareness to software is one way to create differentiation.**

There are two ways to incorporate context awareness into a product: By making it fundamental to the value proposition or by using it to improve the user experience. Each approach has its benefits.

One example where context awareness is fundamental is software based on location data, such as Google Maps. Such products rely on context, including the user's location, friends who are in the same area, and information about current conditions – like weather or traffic.

More commonly, though, context awareness is used to improve the user experience – yielding small enhancements that can generate big returns. Even a slight improvement in the user experience can compound over time in terms of user retention. Satisfied users spread the word to others, who also become users who share their experience. In this way, increasing the level of context awareness can become a powerful tool for software developers to differentiate their product.

### Customers Now Expect a Great User Experience

At SAP.iO Venture Studio, SAP's internal product incubator, we try to build software that solves a meaningful problem in a simple way. **It's important to think about who the identified problem affects and how big the market opportunity is for solving this problem.**

## WHERE



However, to understand the customer, we spend significant time on discovery, interviews, and user research. We explore what matters to users by investigating how they use our products.

This approach helps us deliver the best possible user experience. If we skip that effort, we'll lose out to software that meets those needs. Let's face it: Consumers and business people have a plethora of choices about which products they use. And people expect the software they use at work to be as easy to use as the digital products they use at home.

Not long ago, business software was incrementally more powerful than anything we used for personal activities. Now the applications we use in our personal lives can solve equally complex issues, and the software handles it – while also providing an intuitive interface. Think of apps that prepare your tax return by asking very simple questions, banking apps that analyze your expenses and make recommendations for optimizing your finances, or health insurance apps that help manage your well-being and handle administrative processes with medical institutions. When users spend eight hours a day on their work computer, they expect a similarly great user experience.

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People expect the software they use at work to be as easy to use as the digital products they use at home.

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And there's one more thing to consider. The wide availability of cloud solutions creates a lower barrier to entry for users who want to switch solutions. In the past, it was difficult for users to discover alternative solutions, test them, or share them with upper management.

Today's users can go online, explore different options, and download a free trial version of many software products. They can quickly present a business case to their manager and make the switch to another product. **With users in the driver's seat, developers can't afford to overlook any opportunity to differentiate their software from the competition.**

### Methods and Tools for Getting Context Right

It is important to understand that the cost of getting context wrong is very high. Think about what happens when a hotel extends an offer for a romantic weekend stay to a consumer who is recently divorced or a cable company sends a service offer to a disgruntled former customer. When software gets the context right, it's almost unnoticeable. But when the context is wrong, it's really jarring.

People expect companies to understand them and their circumstances. When software misses the mark, it can catalyze users to switch to another product. Here's how my team works to prevent that. After customer discovery and user research, we begin rapid prototyping. We employ a design-led development approach that allows us to create realistic, live prototypes, even before we've written a line of code.

We invite users to use these click-through prototypes, which look exactly like the ultimate product. As a result, we have feedback from users before development begins. We also seat front-end designers and developers together so they can work as teams. This helps ensure that nothing is lost in translation as we incorporate user feedback into design and development.

Solutions such as [usertesting.com](#) allow us to test and iterate early versions of our solutions. All of our ventures also use A/B testing to compare variables in a proposed solution. Beginning with a small group of users, we test each feature to determine how well it works and adapt our solution based on user feedback.

Developers also must work intentionally, putting themselves in users' shoes. They must be aware of how users will employ the solution, where they'll use it, and which types of devices and experiences they must plan for.

One way we do this is to make sure developers have opportunities to talk with users. Our developers play a part in the support process, because that's where software design issues arise first. Asking developers to take part in solving bugs and receiving user feedback helps them see how the product is being used.

### Planning for Differentiation

To build solutions that will be valuable well into the future, we have to create products that anticipate user needs. This requires access to a wide variety of data sources and the ability to capture huge volumes of data.

Leading companies like Tesla recognize this reality. Realizing that updating hardware is difficult and costly, Tesla added more sensors and cameras into the company's vehicles than the cars currently need. As the vehicle's software applications mature, the hardware will be available to support new use cases.

In essence, you need to think many steps ahead about the data you might want to capture in the future. By actively planning for a world that will have exponentially larger amounts of data and architecting the system accordingly, we can make sure that solutions can scale to accommodate whatever comes next.

It's almost never too late to build context awareness into a solution. But depending on previous decisions and technical debt, it can be much more difficult. The earlier it is in the product development cycle, the easier it is to be agile. Products that are not designed to be modular and to prioritize the capture of context and data are harder to update retroactively to include these features.

I'm excited about the possibilities for context awareness in the next generation of products. **The way we engage and notify users will become more intelligent as solutions take context into account. Ultimately, products will pull users into the experience, rather than relying on users to remember to take action.** Notifications and alerts will also become more intelligent, with users informed on the right device at the right time.

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When software gets the context right, it's almost unnoticeable. But when the context is wrong, it's really jarring.  
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Later on, we may see user interfaces that fundamentally shift based on the type or context of the user. Maybe financial software will adjust the information it displays based on the proximity to month-end closing. Or imagine a travel expense application that recognizes when a user is in a taxi on a business trip. It could display only a simplified receipt capture screen instead of the more complex product home page needed to generate a full expense report.

Context awareness will continue to mature, bringing the surprise and delight that users get from their consumer experiences into the business-to-business software world. By building context awareness into these solutions, developers can not only introduce consumer-grade innovations to business software, but they can also make the work life of users easier. And that's the best way of all for companies to differentiate their products.



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