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Industry perspectives

During the preparation of this publication, we benefited greatly from interviews and conversations with the following executives:

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Enter the computer. In a review of Chess Metaphors, Garry Kasparov (the chess grandmaster and former World Chess Champion) described what it was like being one of the few grandmasters whose life in chess spanned both the before and after periods in which computers impacted the game.¹

He played 32 “chess computers” simultaneously in 1985 and beat them all. Eleven years later, in 1996, he barely defeated IBM’s Deep Blue; the next year in 1997 he lost to a new and improved Deep Blue—an event that made headlines around the world.

The experience was transformative for Kasparov, but it did not lead him to the obvious conclusion that computer intelligence will supplant human intelligence very soon. That’s because Deep Blue’s “intelligence” represented an exhaustive, computationally intensive search of all possible outcomes of a limited set of move options facing the chess player. Human intelligence works at a higher level, looking for familiar patterns and making decisions.

Message from the editor
The game of chess has been calculated as supporting $10^{40}$ positions for the 32 various chess pieces or chessmen. As daunting as it is to conceptualize a number that large, try thinking about the $10^{20}$ different possible chess games! Perhaps we can simplify things, as Diego Rasskin-Gutman did in his book Chess Metaphors. He pointed out that a player trying to consider all the possibilities of just the next eight moves by both players encounters a number equivalent to all the stars in a typical galaxy. It’s no wonder chess has been called the most cognitively challenging of all games.

Business leaders and staff operate in a realm of similar uncertainty that can be considered even more challenging than chess. More than 32 “chessmen” are in play, and the rules guiding the behavior of suppliers, employees, partners, competitors, and customers are far more fluid, even unknowable. Yet decisions must be made despite all this uncertainty; not making a decision is the same as making one.

based on patterns. But patterns are conceptual; they can hide fatal flaws in the next series of moves that are otherwise conceptually similar. Kasparov recognized that computers could easily check for those fatal flaws and signal the player not to follow a particular pattern of play. He even proposed a new style of play he called “Advanced Chess,” which explicitly allows a single player to have a computer at hand to check for such fatal flaws.

But why have a human involved at all? Didn’t Deep Blue prove no humans need apply? The answer lies in how chess tournaments have evolved since Deep Blue’s arrival on the scene. These newer forms of chess invite humans and machines to the table with fewer constraints. Freestyle chess tournaments allow pure human, pure machine, and any combinations of humans and machines to compete.

In a 2005 freestyle tournament, the winner was not a grandmaster playing alone, or a machine playing alone, or a single grandmaster aided by a single powerful computer. The surprise winner was a team of two amateur chess players using three computers at the same time. The secret to their success was the interaction between the humans and the computers—the different types of intelligence were “coaching each other” in a distinctive process. As Kasparov concluded, “Weak human + machine + better process was superior to a strong computer alone and, more remarkably, superior to a strong human + machine + inferior process.”

This issue of the Technology Forecast examines the future of enterprise applications. Our starting assumption was that many high-value “business activities” are actually cognitively challenging mental processes, not unlike chess. Were there any applications that could have been inspired by the lessons from the freestyle chess movement, that combining human and machine intelligence in a strong process creates the most effective results?

The answer to that question appears to be yes. A confluence of trends such as mobility, cloud, application programming interfaces (APIs), analytics, and others are giving rise to apps, which we call mindful apps, that blend human and software intelligence and make human cognitive processes part of the enterprise business processes. In doing so, these mindful apps expand the purview of enterprise applications to include human thinking and augment humans’ capacity for knowledge work.

The article, “The future of enterprise apps: Moving beyond workflows to mindflows,” on page 06 explains the rise of mindful apps, what they are, and how they optimize the human element by building support for thinking processes as part of any business process.

“Technologies that enable mindful apps” on page 28 looks at the collection of methods and technologies involved in the design, development, and deployment of mindful apps.

The article, “The mindful CIO,” on page 46 explores the key role CIOs and IT staff can play in the development and adoption of mindful apps.

This issue also includes interviews with executives and thought leaders at enterprises that are demonstrating leadership with the future of enterprise applications:

- Chris Leone and Steven Woods of Oracle forecast how digital body language, mobile form factors, and the cloud will reshape enterprise applications.
- Sam Liu of Partnerpedia explains how the world of mobile and cloud apps will converge with the world of desktop apps.
- Pat Garrehy of Rootstock Software details how integration-ready applications will enable users to create their own interfaces to fit their work.
- Isaac Sacolick of McGraw Hill Construction explains how personalized apps create business value.
- Bill Murphy of Blackstone describes why the user experience is an underappreciated critical success factor.

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As always, we welcome your feedback and your ideas for future research and analysis topics to cover.
The National Football League in the United States replenishes its talent through the draft, each year choosing a few hundred players from 12,000 college athletes. A franchise’s workflow for the event involves gathering every statistic imaginable for each player, collecting qualitative assessments from scouts, and ranking players overall and by position so the general manager is ready to choose when he is “on the clock” in each draft round.

During each round, a team typically selects the best overall player still remaining, or the best player available for a position it needs. On the surface, the drill does not appear more complicated than that, but it is—starting with the fact that the workflow just described hardly represents the many variables and nonsequential nature of the process.

To better manage the multivariate complexities, the San Francisco 49ers professional football team partnered with SAP to create an application that not only provides speedy access to all player stats, but also supports the processes that occur in the minds of the humans making or influencing draft picks, including the general manager, the player personnel executives, the scouts, and the trainers.

The SAP solution supports cognitive processes, such as comparing players and analyzing performance, while respecting intuition, experience, and debate among deciders and influencers. “We’re getting in the mind of the customer and being empathetic,” suggests Jonathan Becher, chief marketing and communications officer of SAP. “We are getting to their mindset.”

The software helps the team understand the players available at any moment, analyze how they would help relative to the current roster and other possible picks, and how they fit in the context of the team’s offensive and defensive philosophies. Through a guided dialogue, it helps the scouts, player personnel executives, and general manager answer questions as they arise while they watch a player, debate a selection, or make the choice. The software pulls up player details in response to queries, and by analyzing queries over time, it anticipates what the user is after, making correlations on its own—similar to the way some mobile consumer apps operate.
Encouraged by the trend toward contextually aware mobile apps, enterprises are starting to request—and software developers are beginning to create—business applications that include the essential workflow automation but go well beyond it to incorporate support for the human cognitive processes as part of the overall business process.

PwC calls this new type of application a **mindful** app because it incorporates the mindflows of cognitive processes, in contrast to the workflows of the business processes at the core of standard enterprise applications, and it focuses on the “now” by delivering intelligence in the moment. Mindflows are the patterns of thinking that knowledge workers use while doing their work. By now, enterprise software has so effectively automated business process workflows that it actually raises the level of importance of knowledge work, because that is where the human being can add value.

This first article in this issue of the Technology Forecast examines why and how enterprise applications are on the verge of becoming more mindful. The two companion articles explain the underlying technologies and how CIOs and other business leaders can begin to develop and deploy them across an organization. (See the article, “Technologies that enable mindful apps,” on page 28 and the article, “The mindful CIO,” on page 46.)

**From workflow to mindflow**

Long before the digital age, the idea of automating workflow dominated the thinking about business processes because it was—and still is—the key to efficiency, consistency, and other virtues required for large-scale production, distribution, and support. As much as possible, enterprise resource planning (ERP), customer relationship management (CRM), supply chain management (SCM), and other enterprise applications minimize any wasteful variability humans can introduce to a process and let the application control it. No wonder most companies have widely adopted these applications to automate their workflows.

Automation has done wonders for business, taking the power of the assembly line of Henry Ford’s day to the global scale of today, where the notion of making, selling, and distributing millions or billions of something is normal. But not everything can be standardized and turned into a software-dominated process workflow. Not everything should be. Businesses understand this concept implicitly, which is why they have knowledge workers to solve problems, integrate new information with old and make decisions, and rapidly respond to unanticipated events.

For example, repair technicians need to assess a machine and figure out what to do on the basis of their experience, education, and intuition. Salespeople need to do the same when determining prospects and managing the sales pipeline. The same is true for architects, engineers, policymakers, designers, construction workers and other builders, physicians, programmers, spies, teachers, marketers, and scores of other professionals.

Everyone knows the difference between a customer service representative who diligently follows a workflow-based script versus one who is trying to solve the customer’s problem. The one who uses his or her thinking skills is the one who customers prefer and who wins their loyalty.

Such knowledge workers have long used software to help them do their work, but that software has little connection to how business really gets done, other than conforming inputs and outputs (import and export) to other tools. For example, a salesperson will
use sales force automation software to record the details of a potential contract for use in deal pipeline monitoring, but not to analyze a customer and design an offer that has the best chance of closing a deal.

In fact, knowledge activity happens in the person’s mind, in ways that are often idiosyncratic and personal but that tend to follow patterns within each persona or group. To contrast these cognitive activities with workflows, PwC calls them mindflows.

Mindflows are goal-driven thinking patterns—such as comparing, evaluating, and summarizing—used by anyone engaged in complex analysis and decision making. The journey to the goal potentially has many paths and unfolds in an iterative divergence-convergence patterns. (See Figure 1.)

Scientists have studied patterns of thinking for decades and have offered frameworks that can inform the formalization and codification of mindflows. (See Figure 2.)

Oracle’s marketing automation solution, for example, is “modeled around how the marketer thinks,” says Steven Woods, group vice president of software development at Oracle. “I think that’s how today’s software should be designed. How does a human think given a certain task, and how will software mold that thought process?”

The good news is that patterns of thinking are common across many situations in business, whether in sales, hiring, developing strategy, evaluation, onboarding an employee or partner, and so on. Progress results from the dissemination of increasingly complex bodies of knowledge to advance along the mindflow.
Going beyond automation: The rise of mindful apps

The opportunity is ripe for applications to go beyond automation. Unlike the tools that knowledge workers have and will continue to use to create, manipulate, and retrieve the data they need, the new class of mindful apps is about the thinking itself. Mindful apps model human thinking as part of the business process of interest, use context to augment the capacity of employees to conduct knowledge work, and deliver intelligence in the moment.

To go beyond automation, applications need to bring the human cognitive processes into the overall business process and share control of overall progress. While automation limited or took humans entirely out of the business process, mindful apps bring humans back into the process by blending human and software intelligence. (See Figure 3.) “They’re talking to the system and the system is talking back, and that leads to the next question. It’s more of a dialogue that helps them go to and fro, but the dialogue happens to be based on the context and the circumstance,” says Sami Muneer, vice president of product management for sports at SAP.

Mindful apps differ from traditional enterprise applications in many areas. Table 1 contrasts traditional applications, mobile apps, and mindful apps. A mindful app is not a

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"I think that’s how today’s software should be designed. How does a human think given a certain task, and how will software mold that thought process?"

—Steven Woods, Oracle

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Figure 2: An example of a framework for thinking processes and skills

Robert Marzano and others have offered the following framework for thinking processes and skills. The processes are typically multistep and at a higher level of abstraction. The skills are at a lower level.

<table>
<thead>
<tr>
<th>Thinking processes</th>
<th>Thinking skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept formation</td>
<td>Focusing</td>
</tr>
<tr>
<td>Principle formation</td>
<td>Information gathering</td>
</tr>
<tr>
<td>Kinds of principles</td>
<td>Remembering</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Organizing</td>
</tr>
<tr>
<td>Problem solving</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Decision making</th>
<th>Research (scientific inquiry)</th>
<th>Composition</th>
<th>Oral discourse</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Thinking processes

- Concept formation
- Principle formation
- Kinds of principles
- Comprehension
- Problem solving

Thinking skills

- Focusing
  - Defining problems
  - Setting goals

- Information gathering
  - Observing
  - Formulating
  - Questioning

- Remembering
  - Encoding
  - Recalling

- Organizing
  - Comparing
  - Classifying
  - Ordering
  - Representing

A mindful app focuses on the cognitive goal and works backward. App designers accomplish this task by asking the “five whys” to make explicit the mindflows, thinking states, heuristics, and thinking patterns that were formerly implicit.

A mindful app understands context and uses that to aid the person. For example, an app might note related or contradictory information, suggest alternative approaches, or prepare for likely activities to speed the flow.

A mindful app is designed around the user experience, not the workflow. Therefore it simplifies the interfaces, filters information appropriately, and adapts to the user or persona to alleviate cognitive complexity. Users can drill down to get more detail and context as needed.

A mindful app integrates analytics into the user experience to deliver intelligence in the moment. Appropriate data and analysis are available to assist the person in context and as events are taking place.

A mindful app understands there can be many good answers and paths that lead to successful outcomes. Its goal is to aid the user on the user’s chosen path, not enforce a predetermined path. It does so by being pattern-centric and not process-centric the way workflow-based applications are.

These characteristics bring the human cognitive processes into the overall business process, creating a symbiotic interaction where the mindflows and workflows provide the structure and the human provides the thinking skills for carrying out the activity. Take for example an online news magazine such as Zite, available as an app on all major devices. The app is much better at aggregating and presenting information to humans. Humans decide what is relevant and indicate what topics they prefer. The app learns from the user and over time gets smart and narrows the information it presents to the user. If the app were to do it alone, it would be less efficient and effective in telling the user what to read. If users worked alone, they would spend a lot of time searching. But the combination has made the reading experience better, richer, and symbiotic.
At an abstracted level, mindful apps allow users to do the following:

- Efficiently assess and compare their options in a decision context
- Respond quickly to an event and make the best decision possible within the context of intelligence in the moment
- Understand and recognize patterns and discover cause and effect
- Discover and generate distinctive options they may not have otherwise considered

“Think about Wayne Gretzky. He was the best hockey player ever, because he didn’t skate to where the puck was; he skated to where the puck was going to be,” says Bill Murphy, CTO of Blackstone, an alternative asset management company. Mindful apps help people skate to where the puck is likely to be. “We aim to take away as much stress as possible from the easy stuff, by automating the routine and mundane actions, and give users more time to focus on the higher-end pieces of what they need to do.”

The goal of mindful apps is to reduce the cognitive load associated with low-value knowledge processes. Mindful apps could free human cognitive capacity to analyze and make decisions associated with high-value knowledge processes. Low-value knowledge processes include recalling specific details, recalling past events that are similar but not identical, filtering information so only facts pertinent to the context and that help define differences.

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**Table 1: Comparing traditional applications and mindful apps**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Traditional applications</th>
<th>Mobile apps</th>
<th>Future apps (mindful apps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scope and focus</td>
<td>Large scope, end-to-end process and data-centric</td>
<td>Bite-sized goal-driven services and user-centric</td>
<td>Cognitively manageable scope</td>
</tr>
<tr>
<td>Nature of work</td>
<td>Standardized, deterministic, expects defined paths</td>
<td>Ad hoc, contextual, review-and-react oriented</td>
<td>Ad hoc, probabilistic, expects uncertainty, many paths</td>
</tr>
<tr>
<td>User experience</td>
<td>Same experience for all, users need training to use</td>
<td>Simpler and contextual interfaces, no expectation of training</td>
<td>Simple, contextual, and adaptive interface, users learn intuitively</td>
</tr>
<tr>
<td>Productivity focus</td>
<td>Optimized for groups</td>
<td>Optimized for persona/person</td>
<td>Optimized for individuals and harness power of the group</td>
</tr>
<tr>
<td>Driver of experience</td>
<td>Workflow driven</td>
<td>Goal, context driven</td>
<td>Mindflow driven</td>
</tr>
<tr>
<td>Relation to analytics</td>
<td>Separate analytics</td>
<td>Integrated analytics</td>
<td>Integrated and predictive analytics</td>
</tr>
<tr>
<td>Primary role</td>
<td>Record data and information</td>
<td>Use data and information in the user experience</td>
<td>Use data and information in thinking activity and user experience</td>
</tr>
<tr>
<td>Delivery model</td>
<td>Dominated by on-premise delivery</td>
<td>Driving adoption of SaaS (Software as a service)</td>
<td>SaaS as the dominant delivery</td>
</tr>
<tr>
<td>Development model</td>
<td>Rely heavily on IT</td>
<td>Business taking some ownership</td>
<td>Business taking more ownership</td>
</tr>
<tr>
<td>Management model</td>
<td>Configuration management database (CMDB)-based model</td>
<td>App store model</td>
<td>Will evolve from app store-like model</td>
</tr>
<tr>
<td>Timeliness of data and analysis</td>
<td>Often delayed reaction</td>
<td>In the moment</td>
<td>In the moment</td>
</tr>
</tbody>
</table>

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“Mobile apps allow me to integrate data and context with the workflow.”

—Isaac Sacolick, McGraw Hill Construction
in choices are highlighted, and capturing details automatically for later recall.

Computer algorithms are exceedingly good at these low-value knowledge processes. Humans are adept at problem solving, pattern recognition, identifying outliers, and incorporating new sources of information to a complex decision context. Computers are not so good at these high-value processes.

Without mindful apps, complex decisions are often made with unexplored tacit knowledge, such as subjective probabilities well known for deviating from objective probabilities. Mindful apps expose these biases and make more explicit the basis for making decisions, even as they don’t predetermine the “best” decisions.

Applications or apps: Does it matter?

This article uses the words applications and apps somewhat interchangeably. Applications usually refer to software deployed on servers and desktops, whereas apps refer to software functionality accessed on a tablet or smartphone. Mindful apps borrow many characteristics from the mobile apps of today; hence PwC calls them apps and not applications. (See Table 1.)

You might think of mindful apps as something new and separate from traditional applications. That needn’t be the case. Many workflows have breakpoints for human involvement. Applications for such workflows are prime candidates for bringing mindful capabilities to the human part of the workflow. Likewise, in workflow applications that constrain human actions for the sake of efficiency, mindful apps could enhance some processes to allow more human flexibility where the best outcome is the intended goal rather than a predetermined result. Therefore, mindful apps are complementary to traditional applications and offer a way to extend the value of the core systems to new use cases that include knowledge work.

Today, mindful apps are most common on mobile devices, because they typically are used in the moment. “Mobile apps allow me to integrate data and context with the workflow,” explains Isaac Sacolick, CIO of McGraw Hill Construction, which has developed mobile apps to bring real-time insights and interfaces to the work of its sales force. In fact, many mobile apps and other consumerization-era apps have introduced the mindful trait, even if their designers didn’t know they were doing so. The contextual nature of mobile and user-centered apps requires less rigid workflows in many cases, leading to basic mindful features.

Navigation software is an example: If you drive a route different from the one suggested because you know a side street is faster than the main street, navigation software adjusts its route based on your actions. It also adjusts its own suggested route based on traffic reports, historic variances such as commute backups, and weather. It’s mindful of the overall context and of the user.

Mindful apps should also exist when you’re in front of a computer, especially as the notion of “being in front of a computer” disappears in an increasingly always-connected, multi-device world. As apps work across computing platforms, mindful apps should become even more capable. That’s because the shift to a mix of computing platforms favors deployment via the cloud, which means apps can move with the user and read local information. If you’re using a smartphone, the app might take advantage of the device’s array of sensors and overcome any internal processing limitations by running

“We aim to take away as much stress as possible from the easy stuff, by automating the routine and mundane actions, and give users more time to focus on the higher-end pieces of what they need to do.”

—Bill Murphy, Blackstone

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Mindfulness can be applied in a variety of business cases, both as new apps and as enhancements to existing software. For example, think of a time-sheet application in which a sales employee logs arrival and departure times, and travel time to client sites. Today, the employee likely enters this information from a mobile device before starting the car to depart for the next appointment. A modestly mindful time-sheet app would notice that an appointment has run long for the fourth time in five visits and suggest a change to the schedule. A more mindful app would also ask the employee, and perhaps his or her manager, if the sales account is proving more difficult or has a larger scope than expected. That question might prompt an assessment of whether the client’s needs differ from what’s expected. Or, it could trigger a discussion that might lead to the assignment of additional resources, or a change to the sales strategy, or other action not obvious from the traditional use of time sheets.

As another example, consider an app that lets HR know how successful a potential employee could be. “We use data we collect in the HR system around a person, and we try to predict answers to questions such as: What is the likelihood that this individual will be an overachiever?” —Chris Leone, Oracle

Some or all of the app in the cloud. If you’re using a PC, the app should have the same context available and also be able to take advantage of the PC’s more capable user interface and likely connections to other resources.

Exploring the power of the mindful app
The Google Now platform, Apple’s Siri service, and many emerging assistant services such as Donna and reQall are examples of mindful apps that transcend individual device capabilities while taking advantage of devices’ unique capabilities. Such apps are likely to form a person’s first impressions of what is possible. “Google Now is a good proxy for the trend in apps that we are all going to be benefiting from in the next 10 years,” says Blackstone’s Murphy. “It’s almost like augmenting users with the best possible personal assistant who is with them all the time. If we can use technology to do that in the enterprise, we will have achieved a lot of productivity gains.”

Google Now is an app for Android or iOS mobile devices, but it’s actually a suite of federated services that Google provides and cross-connects to help people in their daily activities. It tracks where you go, and it monitors your calendar, e-mail, web searches, and browsing history. Using this context, it provides what it considers to be the right information at the time, such as suggesting where to get the best currency exchange rates when you are abroad, alerting you to expected package deliveries, and predicting drive times to your next appointment based on your location, weather, and traffic. Over time, it builds a profile of your preferences—what kinds of restaurants you visit, when you commute or jog, what stores you frequent—and uses these digital footprints to develop a model of your mindflow, reduce the cognitive load needed for mundane details, and free human cognitive capacity for high-value tasks and decisions.

Mindfulness can be applied in a variety of business cases, both as new apps and as enhancements to existing software. For example, think of a time-sheet application in which a sales employee logs arrival and departure times, and travel time to client sites. Today, the employee likely enters this information from a mobile device before starting the car to depart for the next appointment. A modestly mindful time-sheet app would notice that an appointment has run long for the fourth time in five visits and suggest a change to the schedule. A more mindful app would also ask the employee, and perhaps his or her manager, if the sales account is proving more difficult or has a larger scope than expected. That question might prompt an assessment of whether the client’s needs differ from what’s expected. Or, it could trigger a discussion that might lead to the assignment of additional resources, or a change to the sales strategy, or other action not obvious from the traditional use of time sheets.

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Mindful apps can also be much larger in scope, designed specifically to address complex problems that rely on human judgment, expertise, and intuition but that benefit from having detailed information available for context and analysis in the moment.
The future of enterprise apps: Moving beyond workflows to mindflows

The mindflow of the football draft

The SAP sports application is one example. “Traditionally, every team has approached this problem the same way,” says SAP’s Jonathan Becher. “They do linear optimization, in which they say, ‘We’ll see who runs the 40-yard dash in such and such time, who jumps the highest, who catches the most, and so on.’ Imagine if you said instead, ‘We don’t want to find the player with the best stats overall. We want to find the best player for our system in our current environment.’ That may not be the single fastest wide receiver.”

The college football draft is a cognitively intense process. “Teams typically spend half their time collecting the information, 30 percent making sense of it, and 20 percent analyzing it,” observes SAP’s Sami Muneer. The scouts and then the team executives need help in understanding the players available, how they would help the team relative to existing players and other possible picks, and who to choose based on who is available when the team’s next pick comes. There is an art and a science to this process.

SAP used design thinking methodology to engage with the 49ers. Although design thinking has a rich history as a method to understand cognitive activities and apply them in designs, its expanded use also includes studying the underlying cognitive processes in how work is done. SAP used it to design how the software itself acts and adapts when in use. “For us, design thinking is observing users in context and focusing on the overall experience,” says Rishi Diwan, vice president and head of product management for sports at SAP.

SAP quickly realized that the equivalent of an HR recruiting system would not help sports teams make the best decisions. “Coaches, scouts, and executives have a certain way of expressing; they have a certain way of understanding. They all take pride in their analysis and experience. You can’t throw charts at them or have the computer drive their behavior. They’ll check out right away. You need to understand their mindset,” Muneer says.

SAP concluded that any solution needed to do the following:

- Efficiently assess and compare candidates
- Enable quick responses to events (such as injuries, change in performance trajectory, or a player unexpectedly not being available for selection)
- Recognize patterns and their implications for the team’s draft strategy (such as correlating performance close to injuries or with playing time)

The 49ers’ early experience is that they can deeply assess many more players than was previously possible, and they believe they’re asking better questions and getting better answers. Thanks to interfaces that are mindful of cognitive complexity and the pertinent and necessary information to the task at hand, they can comprehensively understand players in minutes rather than hours. (See Figure 4.) It’s difficult to calculate a traditional ROI because ultimately any team is matching their collective judgment against that of other teams, and a smarter process’s results may not be obvious immediately or even be better in every circumstance. The goal is to increase the odds of success by helping people do what they do better.

“You need to understand [users’] mindset.”
—Sami Muneer, SAP

The business benefits of mindful apps

If you can’t show a 10 percent labor reduction or some other measurable ROI, how can you justify mindful apps? That’s partly a trick question. Mindfulness should not replace efficiency or standardization. If a company can show ROI for achieving further efficiency or standardization, it should do so.

But most large businesses are approaching the limits of operational efficiencies that IT systems can deliver, because they have largely succeeded in their automation and standardization goals. That leaves the nonautomated work—the work done by people—as the opportunity for greater effectiveness. Effectiveness—getting the best results possible—is a crucial goal for human processes.

The metrics are fuzzier—customer satisfaction, quality level, brand reputation, and so on—but over time an effective company should make more money than a merely efficient one. Apple, for example, makes nearly half the world’s PC profits, despite a market share of less than 7 percent. Its manufacturing operations are very efficient, but that’s not why it makes so much more profit. The reason is that the company can charge much more because of all the attributes people associate with its devices and services. It’s more effective than its competitors. And that’s better for its bottom line.

In other words, you want to be both efficient and effective.

Marketing automation is one area where mindful apps are appearing in business. It is a discipline that relies on analytics, workflow, and human judgment. Many tools can efficiently distribute marketing messages to customers and would-be customers over

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The future of enterprise apps: Moving beyond workflows to mindflows

e-mail, telephone, websites, and postal mail. They can even segment audiences for some form of targeting. But the decision to buy something is ultimately a human one, based on the idiosyncratic requirements of each person, individuals at a company, the internal procurement process, the vagaries of budgets and time frames, and the judgments buyers make on the path from product identification to purchase decision.

Several vendors, including Oracle’s Eloqua subsidiary, Marketo, and Teradata’s Aprimo subsidiary, provide mindful marketing automation apps. They’re mindful because they use the digital footprints—browsing, downloading, social networking commentary, e-mailing, and tweeting—of potential buyers to understand their mindflows and predict where they are in the buying cycle.

“The paradigm for the interaction architecture in Campaign Canvas [Oracle-Eloqua’s product] was really designed to model, as best as we could, how a marketer worked on the whiteboard to the point that it’s not just the flow but the sequence of thoughts of the marketer,” Oracle’s Woods says. The tool can also be used to model the mindflows in other use cases. An example of its use in an employee onboarding process is shown in Figure 5.

These mindful apps seek to understand customer attitudes and interest levels relative to a company or its products. Often, gaining this understanding includes correlating digital footprint data with internal salesperson reports and logs. That information lets marketers target their communications with content at the moment it is impactful. What makes such impact possible is what Woods calls the digital body language.4

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Much of what now happens inside and outside an enterprise happens interactively in digital environments. The total of the digital footprints of any customer or employee is their digital body language. Just like a buyer’s physical body language provides cues to a seller about the buyer’s interests and inclinations, digital body language does so in the digital domain where the buyer and seller do not interact in person.

“If you start looking into the psychology of interests, it’s highly dependent on the context of that user’s world at that moment in time,” Woods says. “If you put the same piece of information in front of me at a different moment in time, at a different stage in the projects I’m working on, I’m going to tune it out very, very quickly.” As any marketer knows, you have to figure out a way to get a message in front of someone who is interested in your topic at the moment they’re interested in it. This is being effective.

**Conclusion**
Throughout the long history of enterprise applications, software has influenced different flows of activity in a business process. As Figure 6 shows, enterprise IT started by supporting commercial transaction flows. Over time, the transactions were stitched together into end-to-end processes, and application support evolved to workflows that optimized group work. ERP systems are the best example.

Information about the transactions was important, so management could monitor the business and make decisions. Thus, information was freed from the transaction systems and flowed in to and out of rationalized, organized data warehouses through data marts to end users, evolving the support to information flows.

As social and collaboration platforms have become popular, and executives recognized the importance of efficiently transferring knowledge through human interaction (even if digital), the support has evolved to knowledge flows within and outside the enterprise.
Each evolutionary step created the potential for IT to participate in a new level of business activities. Also, as technology has extended its reach from transactions to workflows to information to knowledge, it has gradually reduced the time it takes for a significant business event to become broadly known—and responded to.

The next new level of engagement between applications and the enterprise is the flow of thinking at the individual user level—what PwC calls mindflows. And the next frontier in business value creation is targeting effectiveness by guiding employees to do the right thing. Mindful apps, designed to aid human cognitive processes and deliver intelligence in the moment, are beginning to appear in the consumer and business worlds alike.

Mindful apps are in their early days, with plenty of value to be gained and opportunities to be exploited. Smart companies will make sure that making people smarter, better informed, better able to judge, and more effective is a key priority.

**The next frontier in business value creation is targeting effectiveness by guiding employees to do the right thing.**
User mindsets are driving the future of applications

Jonathan Becher, Rishi Diwan, and Sami Muneer of SAP describe how they use design thinking to understand user mindsets and tap into new sources of value creation.

Interview conducted by Vinod Baya, Bo Parker, and Bud Mathaisel

PwC: Jonathan, what is changing the most in the enterprise applications business today?

JB: I think what’s disrupting enterprise applications is the realization that we were subjugated to false tradeoffs over the last 30 years. We believed we had to choose between all the data or real-time data; choose between complexity or simplicity; choose between beautiful user interfaces or completeness of vision. We believed we had to choose between OLTP [online transaction processing] or OLAP [online analytical processing]; choose between systems of record or systems of engagement.

Whatever your definition of application is, all these false tradeoffs that we believed existed in the last 30 to 40 years don’t really exist. We’re finally realizing there are no tradeoffs; we live in a world of applications. We must do all of these things. There is automation and engagement; it is batch and real-time; it’s complex and simple and so on.

PwC: How will applications in the future be different from the ones in the past?

JB: The designs of the past were based on automation. For instance, the CRM [customer relationship management] solutions were designed for forecasting revenue for the week, month, or quarter and to automate the process so a person doesn’t need to call people on the phone or e-mail spreadsheets around. Also, the solutions were designed for the five, six, or ten sales operations people who report to the VP of sales or to the board. They were designed for a relatively small number of people who...
want a specific bit of information—not designed for the masses. People who use it, the salespeople, are not the people who usually get the benefit. For example, if 10,000 salespeople use the system at a large company, the benefit was designed for 70 people who are actually tracking the pipeline.

Almost every application in the last 20 years has that vice, which is the people who use it aren’t the people who get the benefit. What’s starting to happen is the system is being designed for the people who use it the most, and they’re the ones deriving economic benefit. So, if it’s for salespeople who are traveling, it might help them find the shortest path to the next sales call, to get tips on what services their customers might be interested in, and so on.

Another important difference is that in the past, we users always had to adapt to the way the systems were designed. We get training manuals; we do courses. This approach has changed. The metaphor we’re moving to is where the systems adjust to the user.

**PwC: Can you share an example?**

**JB:** Sure. The application we built to help football teams draft players has the features I described. This example is about sports, but in business there are parallels to talent management or hiring talent from a large pool of candidates.

If you’re a professional football team and you want to draft players, a limited number of people are in the draft and everyone’s competing for the same players. Traditionally, every team has approached this problem the same way. They do linear optimization, in which they say, “We’ll see who runs the 40-yard dash in such and such time, who jumps the highest, who catches the most, and so on.” They all have the same set of data, and they all try to do linear optimization: “I want the fastest wide receiver; I want the heaviest lineman.”

Imagine if you said instead, “We don’t want to find the player with the best stats overall. We want to find the best player for our system in our current environment.” That may not be the single fastest wide receiver.

**PwC: How is the development process different for this application?**

**JB:** The approach we used in developing this application is called design thinking. We started with the San Francisco 49ers [American football team in San Francisco] but we now have applications that are useful for other football teams and eventually for other sports. I’ll let Rishi and Sami, who are leading the development of the applications, provide the details.

**RD:** For us, design thinking is observing users in context and focusing on the overall experience. The application that we built for the San Francisco 49ers is now called SAP Scouting.

So far, enterprise software has focused on the big problems that are common across enterprises. But the various roles or personas have issues of their own.

The metaphor we’re moving to is where the systems adjust to the user.

—Jonathan Becher

So, increasingly we see applications targeting specific roles and personas in specific industries. We identified and studied four personas relevant to the SAP Scouting application suite: the general manager, player personnel executives, the scouts, and the trainers. The designs focus on specific personas with specific experiences in the application.

Although the personas have unique needs, we observed that there is also a hierarchical collaborative flow in how decisions are made. So the application needs to support each of the personas as well as respect the hierarchy within the group—in a sense, recognizing that some personas provide input, others make the decision, but there is rich collaboration in sharing information and point of view. As Jonathan was saying, the application benefits everyone who uses it and not a select few.

**SM:** Our goal with design thinking was to understand what they’re trying to do, how they do it, and then work backward to the design of the experience in an application. Typically, about 12,000 players are in a college draft. The scouts go out and collect a lot of information. They’re in schools, jotting down notes and watching film. They capture the notes in shorthand. They come back to the hotel and type their notes into the computer, and so on. Essentially they aggregate lots of information and opinions on the prospective players.
By understanding first what the 49ers are trying to accomplish, it led us to the realization that the app needed to do three things. The first is to efficiently assess and compare players. The second is to respond to events quickly. The third is to understand and recognize patterns in the data and their predictive utility.

**PwC: How is design thinking changing the way you develop applications?**

**RD:** It’s all about user experience. To us, being experience focused includes two elements: one is that interfaces are pleasing to look at, and the second is that they are relevant to the task at hand—so, contextually aware. By focusing on these two elements, we could take a lot of complexity out of their current experience. As an example, our scouting app initially targeted 20 or 30 screens; by focusing on the user’s context and developing a model of how they think about the decisions they need to make, we reduced it to 2 screens.

The app should also be designed to make it easy for users to do what they need to do. The goal is to present information in a way that’s cognitively easier to process. Whereas before they had tables and numbers that take time to scan, we created designs so users can make the quantitative judgment at a glance and then very quickly focus on the qualitative side. The human reasoning is much more involved in the overall experience, but we take away the stress of wading through a lot of information.

**SM:** Because coaches, scouts, and executives aggregate lots of information, the key challenge for us was to understand how they assess this information. The variance in the user personas is huge. They have a certain way of expressing; they have a certain way of understanding. They all take pride in their analysis and experience. You can’t throw charts at them or have the computer drive their behavior. They’ll check out right away. You need to understand their mindset.

They have to look at the software and understand what they need to do. They need to know what they need to know at that point in time and not anything more. That’s where design thinking comes into play. The expression of the information must be in the context they are in. Why organize information in a way that doesn’t help them do what they need to do, whether it is comparing players or responding to events or another context?

**PwC: How do you understand the mindset?**

**SM:** We ask them lots of questions. We ask them, “Why do you care about this information? How do you normally consume this today? What artifact do you use? Now you’re looking at the information, so what are you trying to understand? What do you want to do next? Why? What would you like to do that you haven’t been able to?”

We try to get at that flow and draw it out. We also try to get at what would be ideal scenarios for them. If they had the best scenario, how would they do it? Often they get very animated. They say, “I wish I could just click on this; I wish I could just go like this; I wish I could just look at this; that’s what I have never been able to do before.” That feedback gives us the mental model. That also helps us understand where they want to go next. And that gives us an idea of the map of their mindset.

These maps are not process-centric; they are pattern-centric. We try to understand the underlying patterns, and that informs the design of the software because the patterns are the scenarios we need to support. We use design thinking as a way to translate from implicit knowledge, gut, and experience to explicit and systematic knowledge that helps the institution collectively.

**PwC: What have you learned about the dynamics between the users and the software?**

**SM:** They’re talking to the system and the system is talking back, and that leads to the next question. It’s more of a dialogue that helps them go to and fro, but the dialogue happens to be based on the context and the circumstance. Sometimes they just need some quick information. Sometimes they really want to go deep and ask a lot of what-if questions. They may want to know what it is they don’t know, so they’re in an exploratory mode.

Having that power to just know something is transformative. Once they get used to it, they feel helpless without the software. They’re constantly saying, “I want to know this player. What about this?” And they think of something else and ask the next question. The questions they have are the things they’ve worked through in their mind.
Additionally, if all you really want is an analytical application that takes data out of your core transaction systems—and now increasingly web, social, and mobile sources—HANA can do that in a simpler way than building a big data warehouse in the sky. This way HANA can drive a better user experience across all the interactions and analysis in real time using systems you already have.

Lastly, leading CIOs—especially those who partner with the business to take advantage of new opportunities—are running new, dramatically rethought real-time applications built on HANA. Examples include predictive maintenance, real-time MRP [Material Resource Planning], personalized health, and several applications built by startups on HANA.

What we have done is disrupt ourselves, so the end customers see very little disruption whatsoever.

PwC: Are there any challenges that you need to address?
SM: As a result of our design thinking study and application, they are thinking and learning themselves. Their patterns of behavior are changing as they become more effective and efficient with the software. This sets up a new dynamic between the software and the user as they learn and change over time.

PwC: Are the domains where you are applying design thinking and developing such apps different from previous domains? It looks like they are more about knowledge-centric work?
SM: The scouting process is much more analytical or knowledge-centric. It’s not like PLM [product lifecycle management] with structured projects and so forth. In a way, we do collect and store the information in a system of record that is the underlying foundation. Where design thinking was most important was the human interface to that information in a new, contextual, nonintrusive way.

PwC: What is the impact of your work with the sports application across other products and solutions?
JB: Everything we do is using design thinking. Our design thinking professionals engage with customers all over the world and conduct workshops. We have had situations where customers are skeptical about the workshop. But often at the end of the workshop they say, “Oh, you’ve got to come and see.” We’re getting in the mind of the customer and being empathetic. In two days we simulate actual work. We try to understand, “At this point, why did you do this?” We are getting to their mindset.

“PwC: What is the impact of what you are doing with design thinking on your existing solutions and their path forward? What should CIOs be aware of?
JB: I’m going to oversimplify the answer and in doing so skip a million really important things. But the biggest change that happened in SAP in the last year is that HANA has rapidly matured from an in-memory analytics tool to a completely rethought database and platform for applications. Design thinking provides a way to design any new experience and express it in a future application on HANA. This provides the freedom to think beyond traditional boundaries and have a platform to realize the dream in a simple and yet powerful way.

HANA is now under everything, including the old transactional applications, in a way that’s mostly invisible to the average CIO and runs faster without change to the application. Additionally, if all you really want is an analytical application that takes data out of your core transaction systems—and now increasingly web, social, and mobile sources—HANA can do that in a simpler way than building a big data warehouse in the sky. This way HANA can drive a better user experience across all the interactions and analysis in real time using systems you already have.

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“We use design thinking as a way to translate from implicit knowledge, gut, and experience to explicit and systematic knowledge that helps the institution collectively.”
—Sami Muneer

“The goal is to present information in a way that’s cognitively easier to process.”
—Rishi Diwan
Using digital body language to transform applications

Chris Leone and Steven Woods of Oracle forecast how digital body language, mobile form factors, and the cloud will reshape enterprise applications.

Interview conducted by Vinod Baya and Bo Parker

PwC: Chris and Steve, collectively you represent ownership of a wide range of applications at Oracle. From your viewpoint, what trends are defining their future?

CL: We focus on developing solutions that help managers and employees do their jobs better. Many emerging technologies are playing a role, such as cloud, mobility, big data, and social. It really comes down to the consumerization of the application experience. Users spend their off-hours on consumer services such as Facebook or LinkedIn, or shopping on Amazon. They expect to have similar experiences in their business work with business applications.

Another significant trend impacting applications is the use of tablets is increasing. Tablets are displacing PCs. The majority of executives at Oracle use tablets for their work. They have their PCs, which they leave at their desks, but they get a lot done on a tablet. Everybody also does work on their smartphones. Where it makes sense, I think we’ll see more and more processes move to the mobile form factors. So we’re designing for those usage patterns today. In our latest release of HCM [Human Capital Management], every single self-service function is available on any mobile device.

SW: In addition to what Chris has said, a key trend that is shaping the future of applications is what I call digital body language. We use this concept in our marketing automation product, but it is increasingly applicable to all functions.
If you look at information flows in buying and selling, they were very different before the Internet compared with the way they are today. Before the digital era, information was a fairly rare commodity. To learn about a vendor, you had to interact with the vendor via a series of conversations. With that interaction, a professional salesperson had the opportunity to understand buyers and their interests through their body language and their reactions and so on.

Fast-forward to today, and the information flows are fascinatingly different. The buyers have complete control over where they get their information; they search, read reviews, and compare specifications and opinions. The digital channels disintermediate the conversation that sales was able to have. Salespeople can no longer read a buyer’s body language and understand their interests.

Salespeople still need to get the insights that they used to get. That is where the concept of digital body language comes in. A marketer should use online behavior information to understand the hot buttons and interest levels of every potential buyer and put together a view of that buyer’s digital body language. Then they can engage their peers and the sales organization and say, “Here are the people you should be talking to. Here’s what they’re interested in, and so on.” I think organizations that can piece together that view of a customer based on the aggregate of their digital behavior and then use that information in all aspects of their organization—those are the organizations that are really well set up for success in the future.

**PwC: What characteristics are new for applications today compared with the past?**

**CL:** One key characteristic is the ability to look ahead and predict user interests or anticipate actions. Again borrowing from the consumer world, when you go to Amazon, for example, there is a prediction engine that says people like you also bought this other product. Essentially, the prediction engine helps customers get the right kind of products based on predictions from patterns learned from a broad population of consumers. We’ve taken that model and applied it to human resources [HR], as an example.

Techniques such as the digital body language that Steve described are also a resource for looking ahead. We use data we collect in the HR system around a person, and we try to predict answers to questions such as: What is the likelihood that this individual will be an overachiever? What is the likelihood they might succeed in this organization?

**SW:** I agree that prediction is a key new characteristic. Anticipating human behavior involves two major themes. One is the comprehensiveness with which we understand the individual. The other is an understanding of who else in the ecosystem is most like an individual and what their interests and next steps were. That really gets back to broadening the understanding across all aspects of your business. Everywhere the business interacts with an individual should be part of a single view of that individual. So the predictions are based on a valid data set.

**CL:** Social is another significant trend impacting the future of applications. In our next-generation cloud applications, every single major object is what I call socially active or socially aware. As an example in sales, if I am interacting with an opportunity, everybody who is participating around that opportunity receives updates in their activity stream. If an opportunity state changes from 50 percent to 80 percent probability of closing on a contract, everybody gets updated. Everyone starts to respond and react faster since important business events are placed into the social data stream.

**PwC: What design principles are defining the development of your apps today?**

**CL:** We’re developing for a SaaS [software-as-a-service] world, especially for Fusion and other cloud applications. We’re developing and optimizing for customers to run in a public cloud SaaS environment. We make it easier to set up, have public APIs [application programming interfaces], and enable extensibility. You can go very deep with extensibility and still be on a common code base. The design principle is the consumerization of IT in a cloud world.

**SW:** In a world overwhelmed with media and messages, the important thing is access to interests of the user. If you start looking into the psychology of interests, it’s highly dependent on the context of that user’s world at that moment in time. If I have a certain problem that I’m dealing with right now, then there’s a certain universe of information that I’m interested in right now. If I get that kind of information, I will be very interested in it.

“It really comes down to the consumerization of the application experience. Users spend their off-hours on consumer services such as Facebook or LinkedIn, or shopping on Amazon. They expect to have similar experiences in their business work with business applications.” —Chris Leone
But if you put the same piece of information in front of me at a different moment in time, at a different stage in the projects I’m working on, I’m going to tune it out very, very quickly. This attention really correlates with what is on people’s minds rather than purely the internal workflows of the organization.

PwC: So in some sense, the flow of the user’s thinking, or their mindflow, is driving the application design rather than the process workflow?

SW: I think that is right. That’s really where we’ve tried to drive our philosophical thinking. The design of any application for any business function will exist within the same intensive world of information and media bombardment. They all need to catch the user’s interest and thinking at the moment in time so as to cause the user to take an action that will move them forward in the work they are doing, whether as a consumer or employee.

PwC: How is such mindflow represented or used in your solution, and how do you get at the mindflows?

SW: Campaign Canvas is our tool for designing and modeling the flow of the mind states of the customer. Its design is really predicated on our observations of marketers discussing and designing campaigns. Marketers live on a whiteboard: Here are the buyers I have. Here are the events that I can understand in their lives. Here’s what I want to have happen to them based on those events and following those events. They visually draw this flow on the whiteboard.

The challenge that we observed, however, was when they sat down from the whiteboard, they didn’t have any easy way to say, “Now I want to go build that conversation with the buyer that I just designed. How do I go build it?” So the paradigm for the interaction architecture in Canvas was really designed to model, as best as we could, how a marketer worked on the whiteboard to the point that it’s not just the flow but the sequence of thoughts of the marketer.

It’s really modeled around how the marketer thinks. I think that’s how today’s software should be designed. How does a human think given a certain task, and how will software mold that thought process?

PwC: How does the notion of mindflow and digital body language apply to other domains?

SW: Many of the situations in business are similar, whether you’re onboarding a new employee, a new distribution partner, a new user, or others. Success is predicated on the dissemination of increasingly complex bodies of knowledge to advance further. You must guide a person from the early definitive, “Go here, click this, do this,” to that second stage where they just need to know the way around and how to get answers to their questions. They’re going from sort of a novice to an expert in whatever the knowledge domain is. It’s the same structure of knowledge flow in all these situations.

The notion of digital body language applies here, because so much of what happens in an enterprise today happens interactively in digital environments. Somebody who’s struggling in an onboarding process or a partner development process will have a pattern. They’ll be searching internal knowledge sources. They’ll be sending e-mails to people with questions in them, and so on. So we definitely have seen people use the digital body language concept to resolve other kinds of knowledge challenges.

PwC: Chris, you said you are developing for a cloud future. How is the development different?

CL: There are principally two key differences. First, in a SaaS deployment model, we have a lot more information available to us that we can use to provide insights back to our customers. This is big data and includes external as well as internal data. For instance, in Taleo we have data on about 300 million job applications during the last 10 years. That is 10 years of data. We are categorizing some of the key job descriptions, and we will provide certain benchmark information back to our customers that are subscribing to the service—information about the best sources to hire, the time it takes to hire a new candidate or onboard a new candidate, and so on.

“In a world overwhelmed with media and messages, the important thing is access to interests of the user.”
—Steven Woods
Second, we focus our development efforts on areas that need it the most. Because of the common cloud infrastructure, we have data on what features are used more than others. From a new development perspective, I can simplify the features used more frequently, invest more in them, and prioritize testing on them to ensure the best experience. We also track metrics on the response time on features—by time, by size of customer, and so on. I use this information to optimize certain areas in development.

**PwC: How does the use of contextual information, such as location, impact the applications?**

**CL:** Context makes the applications smarter. For example, we can look at the location of a person and if it is a location they usually do not visit, and they have time on their calendar, then we can see if there are others in their network who are in the building and who they haven’t met recently. We can suggest, “You might want to stop by and meet with this person, as you haven’t met with this person for some time.” Such features are simple today but will become sophisticated over time. Another example is time and labor. You can imagine when a user passes the time clock, it automatically clocks in the user. This capability is something we have as a future deliverable, so clocking in and out can become seamless and accurate.

**PwC: Steve, what is the role of the CIO in marketing automation?**

**SW:** I think the role of the CIO in modern marketing is a critical one if they’re able to engage. For example, the logistics industry moved from being orchestrated around people who understood how to catalog things in warehouses and how to drive trucks to one that was essentially an IT-driven industry. Marketing is the same way. The only way to understand buyer behavior is to look at the digital data. The only way to work with that data and get in front of the mindflows is to analyze, process, and build flows based on that digital data. We have two paths to get there: either marketing teams become more technology oriented, or IT teams become more marketing oriented.

**PwC: Chris, what should CIOs focus on with respect to the future of enterprise applications and how they enable their enterprises?**

**CL:** I think the best CIOs will be those who can generate insights across disciplines. If you are a CIO and your effect on marketing is constrained within the bucket of things marketing, then you really are not a CIO; you’re IT support for the marketing department. If you’re a CIO with a horizontal mandate and you say, “Here are insights that our business collects about who our customers are, what the market trends are, where our products are coming from, and what’s happening with components down the supply chain,” then you are a CIO who actually has executed on a modern CIO mandate and can bring insights to the business that are new, novel, and game changing. By definition, the crux of that is very, very deep, flexible, data flows and integration between line-of-business applications.
Today’s enterprise applications primarily target operational efficiency by standardizing workflows and minimizing human involvement in repetitive business activities. Now, as explained in the article, “The future of enterprise apps: Moving beyond workflows to mindflows,” on page 06, a new generation of enterprise applications is blending human and software intelligence. This blending is particularly true for knowledge work in which reason, analysis, pattern recognition, and related cognitive skills can be supported by software’s recall, filtering, and presentation of intelligence in the moment. Because apps of this type explicitly model thinking in their design stage, PwC calls them mindful apps. Mindful apps engage humans as an integral part of enterprise processes. (See Figure 1.) They do so by modeling thinking and incorporating it into the business process of interest, using context and delivering intelligence in the moment to augment the capacity of employees to add value through knowledge work.

Mindful apps have new paradigms and expectations for user interactions, availability, readiness for integration, and design. New tools, platforms, and services are emerging to meet this new generation of computing challenges. The biggest expectation and impact is in elevating the user experience to a new level of simplicity and timeliness to support how individuals do their work. This article details some of the methods and tools that enable mindful apps across the following three categories:

- **Defining the user experience:** Techniques that surface and model the cognitive processes of end users and become the basis for predicting and personalizing the end-user experience.

- **Developing the user experience:** Tools and platforms to develop the software solutions that power the experience.

- **Deploying and managing the user experience:** Tools to secure, discover, and manage a growing pool of apps, many of which will be mindful; such apps will be designed to support goal-oriented, focused activities while minimizing the user’s cognitive load.

These new tools and methods help designers understand the processes that occur in the mind of the knowledge worker. This activity is...
often idiosyncratic and personal, but it tends to follow patterns within a persona or a group. To contrast these cognitive, thoughtful activities with traditional workflows, PwC calls them mindflows. Mindflows are goal-driven thinking patterns—such as comparing, evaluating, and summarizing—used by anyone engaged in complex analysis and decision making. The journey to the goal potentially has many paths and unfolds in iterative divergence-convergence patterns. (See Figure 2.)

**Defining the user experience**
Mobile technologies have created a deeply personal connection between users and the apps they use on mobile devices. Humans and computers now engage in an ongoing, collaborative exchange. Consumers have come to expect that technology, no matter the platform, will be able to deliver a hyper-personalized experience using the context of their current location, situation, and perceived needs. Whether this expectation is due to people now carrying an always-connected computer in their pockets or the new design patterns embraced by this new digital community, the lasting impact will depend on how well human thinking, or mindflows, is integrated into defining the user experience.

**Methods to understand and capture mindflows**
Capturing mindflows is not about mimicking how users reason, as expert systems or artificial intelligence systems tried to do in the past. Mindful apps leave the reasoning to the user and focus only on the states of thinking: a user’s current understanding, what information a user needs to see, what a user is likely to do next, and so on. The following sections discuss emerging methods that vendors and enterprises are using to model and make explicit the mindflows in the context of a user experience.
Design thinking. As the name suggests, design thinking is a methodology to understand the cognitive or thinking activities anyone uses when doing his or her design work. This technique originated in engineering design and has spread to many other domains. Today it is an important trend in management thinking, particularly in support of innovation and creativity.

Design thinking is especially useful for addressing problems that are not well defined, thereby it is a good fit for the exploratory nature of knowledge work. “Everything we do is using design thinking,” says Jonathan Becher, chief marketing and communications officer of SAP. SAP's design thinking experts engage with customers in multiday workshops. “We're getting in the mind of the customer and being empathetic. In two days we simulate actual work. We try to understand, 'At this point, why did you do this?' We are getting to their mindset,” Becher explains.

As Figure 3 depicts, this methodology focuses on understanding users in context by observing, identifying, and characterizing distinct roles or personas and gathering user stories. The method requires iterative explorations of possible app behavior using rapid prototyping of experiences and frequent conversations with users.

What distinguishes mindful apps from traditional apps is they acknowledge many paths to an outcome—paths that depend on information and human judgment, not on a set of linear steps. Design thinking allows the identification and externalization of multiple paths to a desired goal.

Digital body language. The Internet continues to penetrate daily life. People have gone from visiting a few websites to making ever-greater portions of their total purchases on the web to using mobile computers to share pictures of places they’re visiting—all within the last 20 years. All this online behavior creates a trail of data, or digital footprints. The websites people visit, the e-mails they open, the links they click, the likes they signal in activity streams, the reviews they post, and so on can be thought of as digital body language that, like physical body language, transmits information about themselves. (See Figure 4.) Steven Woods, group vice president of software development at Oracle, created the concept of digital body language when he was the CTO of Eloqua (now a subsidiary of Oracle) and has written a book on this topic.1

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**Figure 3: Design thinking process as practiced in the Hasso Plattner Institute of Design at Stanford**

![Design Thinking Process Diagram](Image)

**Source:** Adapted from Hasso Plattner Institute of Design at Stanford

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What inspired Woods’ concept was his realization that digital channels were redefining marketing and sales activities. In digital channels, a salesperson is no longer able to read a buyer’s physical body language, cues that were once available to navigate the in-person sales process from prospect to close. But what the web took away, the web is giving back. Savvy marketing organizations use marketing automation products to read, so to speak, the digital body language of their customers and position a target’s readiness for different types of marketing content. By delivering the right content to the right target at the right time, these organizations advance their marketing or sales processes.

This concept, which has transformed marketing, will have a similar impact on other processes. “The design of any application for any business function will exist within the same intensive world of information and media bombardment. They all need to catch the user’s interest and thinking at the moment in time so as to cause the user to take an action that will move them forward,” Woods explains.

The use of such data in targeted ads from Google or Facebook is now familiar. Their platforms monitor a user’s Internet searching, status updates, or likes as indications of what a person is thinking and feeling about specific products, services, and even political candidates. Techniques and information associated with digital body language also can deliver powerful predictions of what a person is thinking in the enterprise context. When combined with well-defined models of mindflows associated with how a user’s thinking evolves toward a specific decision or conclusion, digital body language can be a key enabler for orchestrating the overall experience.

Other methods to externalize mindflows. Additional methods to consider when attempting to capture and include mindflows in future apps include the following:

- **Mindful user stories:** A common technique used in design and agile software development, a user story is one or more sentences in everyday language describing what a user needs to do. A story lists the “who,” “what,” and “why” of a requirement in an easy-to-read way that is brief enough to fit on a notecard. Most user stories focus on defining a single best path for accomplishing a task.
The extension necessary to capture mindflows is the identification and support of the multiple paths that can lead to an outcome.

- **Activity-centered design**: Activity-centered design is a design philosophy based on activity theory, in which the goal is to understand the mental capabilities by externalizing cognitive processes. This externalization is achieved by focusing on how a user performs an activity with any technology rather than focusing on the goal or preferences of the user. Activity theory includes methods of understanding any experience of using a technology, finding patterns, and formalizing the interaction.

- **Customer experience mapping**: Customer experience maps or customer journey maps are tools that can assist with identifying and locating all the touch points a customer has when interacting with a service. This technique provides a blueprint of user interactions that are taking place, and it makes explicit what customers are thinking about before, during, and after an interaction.

- **Mind-mapping tools**: In a situation that has many interrelated issues and themes, it can be helpful to diagram how they are connected. Mind-mapping tools can draw relationships between different ideas, concepts, and categories. Tools such as Mindjet, XMind, and FreeMind help to collect and generate diagrams to map relationships for analysis.

Armed with methods for formalizing the mindflows, the next challenge to defining the experience for mindful apps is to take advantage of context and deliver intelligence in the moment.

Taking advantage of context: The key role of mobile devices

If mindful apps are to be impactful at the time of need, they must be available at the time of need. The rise of smartphones—mobile computers, really—uniquely established the possibility of delivering on this promise. They are the one computer that is always with a person.

Smartphones bring a lot of personal context with them. They generate a wealth of sensor information that helps apps to know where, how, and for what purpose a person is using the device. Developments to bring context to apps are taking place in both hardware and software. On the hardware front, the computing systems allocate a separate processor to manage context. For example, Apple’s new iPhone 5S includes an M7 motion coprocessor to compute context, and Google/Motorola’s new X8 compute system has a contextual computing processor. With a separate low-power processor, context can be continuously monitored and made available without draining precious battery life.

On the software front, context-aware platforms, such as Qualcomm’s Gimbal, allow developers to access sensor information and awareness of the surrounding environment. For example, if the phone hears that it is inside a movie theater, it can provide content related to the movie. Gimbal is offered as a software development kit (SDK) and therefore abstracts context information into application programming interfaces (APIs) for use by mindful apps.

Developments to bring context to apps are taking place in both hardware and software.
The sensors and context-computing capabilities collectively define the contextual power that mindful apps can use to anticipate the next action the consumer wishes to take with as little user interaction as possible.

**Delivering intelligence in the moment**

The effectiveness of any mindful app depends on how well it anticipates what the user needs and delivers it as content or functionality in the moment. Two technologies are relevant to this anticipation and delivery: development platforms that are an ecosystem of capabilities and that ease integration to access those capabilities; and real-time analytics so the apps can deliver predictions and analysis as events are occurring.

Development platforms become the foundations for mindful apps into which all other functions, such as analytics, can be integrated. Platforms can be on-premise or in the cloud, such as Fusion from Oracle, Force.com from salesforce.com, and HANA from SAP. There are also platforms specifically focused on integrations between software-as-a-service (SaaS) or on-premise applications, such as MuleSoft and SnapLogic.

Real-time analytics solutions are available from an array of solution providers. Vendors such as Chartbeat and Visual Revenue (acquired by Outbrain) present real-time insights in marketing or online media consumption contexts. Google and Webtrends provide real-time analytics platforms of online advertising data and website traffic data. Splunk and Vertica (part of HP) are emerging as general-purpose platforms for aggregating data across websites, sensors, machines, and other sources, and providing capabilities to process and analyze them in real time.

As explored in the Technology Forecast 2012, Issue 1, in-memory computing is bringing a new level of real-time capability to customers. Solutions such as Exalytics from Oracle, HANA from SAP, and in-memory analytics from SAS are some examples. In-memory technology achieves performance by keeping data in solid state memory rather than reading from disk, a process that adds latency to the process.

Predictive analytics solutions include algorithms and models that provide the ability to predict future actions that a user is likely to take based on current behavior. Vendors such as Angoss Software, Oracle, Revolution Analytics, SAP, and SAS offer such solutions. Increasingly, such analyses make use of big data analytics techniques as they work with large data sets and need access to scalable computing capabilities.

**Developing the user experience**

Mindful apps are complementary to the core system of records that most enterprises have and offer a way to extend their value to new use cases. In that sense, mindful apps do not need to be distinct or separate from core applications, except they bring the data residing in these systems to the point of action where it can have impact. Today many, but not all, mindful apps are on mobile devices because mobile apps have come to represent contextual, bite-sized, goal-oriented solutions—characteristics that they share with mindful apps. Hence, this section will briefly cover the trends in solutions for the development of mobile apps.

During the last five years, innovation for the means to develop mobile apps has occurred at nearly the pace of innovation of the mobile devices themselves. Developers can now create mobile apps using any number of popular languages, ranging from native C++ to JavaScript and HTML. Table 1 details the common mobile development platforms used in enterprises today.

Unlike traditional desktop or web applications, the life span of a mobile...
<table>
<thead>
<tr>
<th>Vendor</th>
<th>Platform type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adobe</td>
<td>Cross-platform</td>
<td>Adobe’s open source project PhoneGap provides a cross-platform approach to build mobile apps using JavaScript, HTML5, and CSS3. It supports a large number of platforms using a JavaScript to native API bridge. Using the PhoneGap cloud-based service, developers can compile a single code base across all supported platforms.</td>
</tr>
<tr>
<td>Antenna</td>
<td>Cross-platform, mobile enterprise components</td>
<td>The Antenna Mobility Platform (AMP) as a Service includes lifecycle management, development, testing, APIs, and mobile frameworks. Antenna’s AMP Services provide a wide range of enterprise and other integration points.</td>
</tr>
<tr>
<td>Appcelerator</td>
<td>Cross-platform, mobile enterprise components</td>
<td>Appcelerator’s open source project Titanium Mobile provides a JavaScript-based approach to build native apps for a number of platforms. Titanium’s JavaScript bridge offers direct access to native UI elements and device APIs. The solution also includes performance profiling, testing services, a component marketplace, and a collection of mobile web services.</td>
</tr>
<tr>
<td>Apple</td>
<td>Cross-platform, mobile enterprise components</td>
<td>Apple development tools include SDKs for the Mac and iOS platforms. Apple’s Xcode IDE provides the only supported method to create and distribute apps for the Mac and iOS platforms. Apple also provides several mobile services through its iCloud platform.</td>
</tr>
<tr>
<td>Google</td>
<td>Native to Android platform</td>
<td>Google provides the Android SDK, native development kit (NDK), and various other tools to support the Android development process. Common platform tools supported by Google are the Android Development Tools plugin for Eclipse and the Android Studio IDE. Also provides several mobile services through its developer API console.</td>
</tr>
<tr>
<td>jQuery Mobile</td>
<td>Mobile web framework</td>
<td>jQuery mobile is a web framework for building mobile websites and embedded mobile apps. It is also an open source framework that provides HTML5-based user interface system for all popular mobile device platforms using the jQuery and jQuery UI foundation frameworks. In addition, developers can benefit from a large plug-in library.</td>
</tr>
<tr>
<td>Kony</td>
<td>Cross-platform, mobile enterprise components</td>
<td>Kony provides a multi-channel approach to build cross-platform apps from a single code base by using web standards such as HTML5, JavaScript, and CSS3. Kony Development Cloud combines and orchestrates data from multiple sources such as web services, legacy systems, and websites.</td>
</tr>
<tr>
<td>Motorola</td>
<td>Cross-platform</td>
<td>Motorola’s open source framework, Rhodes, provides a Ruby-based cross-platform approach to build native apps for a number of platforms. The platform includes an IDE, hosted build services, and many mobile web services.</td>
</tr>
<tr>
<td>SAP</td>
<td>Mobile enterprise components</td>
<td>SAP Mobile Platform 3.0 (SMP3) unifies Sybase Unwired Platform, Sybase Mobiliser, Syclio Agentry and SAP’s mobile technologies into one mobile platform for business-to-consumer (B2C) and business-to-employee (B2E) applications. SMP3 provides enterprise components, APIs, and integrations into the other SAP platforms.</td>
</tr>
<tr>
<td>Xamarin</td>
<td>Cross-platform</td>
<td>Xamarin’s products are based on the Mono open source project, so developers can build cross-platform native apps using C#. Xamarin leverages the platform’s native UI tools and compiles to assemblies, providing a native user experience with full device API access. It offers Visual Studio integration and a component store.</td>
</tr>
</tbody>
</table>

Source: Vendor websites. Note: This list is not exhaustive and not an evaluation of vendors’ products.
app is short; most mobile apps average around 14 months.4 And unlike the PC and desktop world, the mobile world presents a need to support multiple mobile devices and operating systems.

To meet these challenges, development platforms have the following key characteristics:

• Cross-platform: The exponential growth in mobile operating systems and form factors is driving the need for cross-platform, multichannel approaches to mobile development. Platforms are evolving to include a layer of abstraction that allows code to be reused on other platforms.

• Speed to market: To keep up with rapidly changing consumer expectations, mobile development platforms provide rapid application development (RAD) tools to facilitate faster delivery cycles.

• Mindshare and ecosystem: The composable5 nature of mobile allows platforms to differentiate on the richness and range of reusable components. This opportunity has led to the development of open source and third-party component stores, such as the Xamarin Component Store.

The development community has also explored the use of HTML5 frameworks for platform-neutral apps development. HTML5 provides many advantages, although it includes user experience tradeoffs because access to the native capabilities of a device is limited. For example, user experience concerns led to Facebook’s high-profile decision to transition from HTML5 back to a native development approach.6

Hybrid app frameworks have become popular recently. Such frameworks use a combination of web and native technologies to provide the ability to rapidly develop, often in a cross-platform fashion, while reducing the performance and user experience issues historically associated with HTML5 frameworks. The technologies often encapsulate native user interfaces (UI) and other components so they can be used by web technologies such as JavaScript. An example is Appcelerator’s Titanium framework, in which developers construct native UI elements using the framework’s JavaScript bridge.

There are drawbacks to hybrid approaches as well. Users expect the app to act as a native app and not a web application in a browser, and they have little patience for substandard performance. A hybrid approach has limitations on caching data and offline functionality compared to a native app, which can limit the functionality that can be implemented. Sometimes it is also necessary to make changes for platform-specific idiosyncrasies, which removes the benefit of a single code base and raises maintenance costs.

As hybrid approaches continue to mature, mobile app design elements should continue to spill over into desktop and web apps. The impact of mobile design can already be seen in the responsive design approach taken by many large media websites, such as NYTimes.com and BostonGlobe.com.


5 The term composable refers to the characteristics that enable the development of new functionality by combining components of available functionality.

Looking forward, mobile development vendors must address many challenges, in particular:

- **Fragmentation**: Beyond the fragmentation of device sizes and operating systems is the rise of a new class of devices, such as Google Glass and wearable computing platforms. Platforms should anticipate and allow code reuse across a broader array of platforms.

- **Automated testing**: Rising demand for apps, their shorter shelf life, and the growing number of device platforms will continue to stress development speed and the maintainability of mobile apps. Vendors’ solutions will evolve to include testing capabilities, such as those from SOASTA, so enterprises can simplify and automate the testing of mobile apps.

### Deploying and managing the user experience

The design and development of a mobile app are only half the activities needed to launch a solution. The other half is the delivery and deployment channel. Much like development tools, the deployment and management of mindful apps will be influenced by emerging methods for the deployment and management of mobile apps.

The success of consumer app stores has cemented user expectations for how apps are discovered and acquired. These expectations and the employee-driven app-centric movement have turbocharged the mobile application management (MAM) and enterprise app store (EAS) ecosystems. Table 2 presents a sampling of vendors that provide MAM/EAS solutions to enterprises. MAM/EAS systems have gained traction in the enterprise by providing two core capabilities:

- **Security**: MAM/EAS solutions ensure that policies around identity, access control, and encryption are

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Table 2: A sampling of vendors that provide mobile app management and enterprise app store solutions

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AirWatch</td>
<td>AirWatch provides MAM, e-mail, and content management along with features such as licensing, cost management, and volume purchase program integration. It includes capabilities for security and integration across various other platforms in an enterprise, such as mobile, e-mail, and laptop.</td>
</tr>
<tr>
<td>App47</td>
<td>App47 provides an on-premise or hosted MAM solution that has features such as a customizable app store and analytics that include performance monitoring, mobile testing, and crash analytics. It also provides full lifecycle development through a variety of development, test, and production support features.</td>
</tr>
<tr>
<td>Apperian</td>
<td>Apperian provides EAS and MAM products for the enterprise. Apperian integrates with enterprise identity, access management, and other user authentication services. Through policies created when wrapping an app, specific behavior can be enforced on the basis of user role, location, timing, and other criteria.</td>
</tr>
<tr>
<td>MobileIron</td>
<td>MobileIron provides EAS- and MAM-focused products that include security, document sharing, and content management. The products integrate with enterprise e-mail services and SharePoint document storage solutions, and they are available as an on-premise solution and as a cloud service.</td>
</tr>
<tr>
<td>Partnerpedia/BMC Software</td>
<td>Partnerpedia provides EAS products to enterprises and partners. Its AppZone product allows administrators to set app- and user-specific security policies across device platforms. With AppZone, apps and data can be secured without disrupting the user’s personal apps and data. Partnerpedia was recently acquired by BMC Software.</td>
</tr>
</tbody>
</table>

Source: Vendor websites. Note: This list is not exhaustive and not an evaluation of vendors’ products.
enforced on employee devices. Device profile, single sign-on (SSO), identity management integrations, and remove/wipe (taking data off the device) functionality are also cornerstones of security enabled through MAM/EAS solutions.

• Infrastructure: MAM/EAS solutions provide the specialized infrastructure that organizations need, so they can manage configurations and the secure provisioning of apps. This management has been further complicated by the bring-your-own-device movement, which has created an influx of a large variety of devices that have varying capabilities.

To continue to meet the evolving demands of today’s organizations, MAM/EAS solutions need more than their initial core capabilities. Security is an important part of governance but without a flexible solution in place, these lock-down and control methods often inhibit the usefulness and value of the mobile business tool. Finding the balance between security and risk management is challenging. Without that balance, IT and governance will be viewed as adding bureaucracy, not speed.

Leading solutions also include or will need the following key characteristics to support mobile management goals:

• Multiplatform: Support multiple mobile operating systems, or at least the major vendors

• Unified security policy or approach: Enable security policies on all devices across platforms through a single interface or integration point

• Licensing management: Proactively manage and reclaim or retire software licenses, thereby reducing IT spend

• Analytics: Track how, when, and where an app or component is used, providing critical insight into the use of an organization’s mobile investment

• Content access management: Provide robust access control over which apps are available to whom, and extend integration deeper into apps to manage content access

As the number of apps and associated content increases, the need for features that discover helpful apps for a particular user also increases. In an environment with hundreds or thousands of apps, only a handful might be useful to any one person. How they are filtered becomes important. Matching apps to users can involve sophisticated algorithms that use information from a variety of sources such as identity systems, usage data, and an understanding of the process that any app is in and the roles it is designed for.

App stores today primarily manage mobile apps. That is expected to change. “An app store is an excellent way for users to find and access an app, whether it’s a mobile or a desktop or a cloud application,” says Sam Liu, vice president of marketing and business development at Partnerpedia, an MAM vendor. He forecasts a convergence to a single management solution to manage apps on all platforms, mobile or not.

“An app store is an excellent way for users to find and access an app, whether it’s a mobile or a desktop or a cloud application.”
—Sam Liu, Partnerpedia
As mobile paradigms become mainstream, traditional applications and mindful apps are borrowing from mobile fundamentals.

More vendors are entering the MAM/EAS market, providing alternative approaches and services built on top of a core MAM/EAS platform. These vendors are working to solve not only security issues but also to provide approaches for better app and content management. Table 2 highlights some of the vendors providing MAM/EAS solutions.

With the continued move away from monolithic apps toward smaller, more narrowly focused solutions, the need for better app management will be great. MAM/EAS solutions must evolve into portal-like solutions that provide not just discoverability but also access to content, files, analytics, and other advanced features, as shown in Figure 5. These future MAM/EAS solutions may even become the bridges between enterprise data, partners, and customers.

**Conclusion**

The future of enterprise applications will unfold with the rise of mindful apps—apps that model human thinking as part of the business process of interest, use context to augment the capacity of employees to conduct knowledge work, and deliver intelligence in the moment. Although mindful apps don’t need to be mobile, many are. That is because the mobile platform is personal, brings with it considerable context, and can support users in the moment. In contrast to workflows, which have been the foundation for enterprise applications thus far, the foundation for mindful apps will be mindflows, which are goal-driven thinking patterns—such as comparing, evaluating, and summarizing—used by anyone engaged in complex analysis and decision making. Enterprises have access to methods and techniques such as design thinking, activity-centered design, and digital body language that externalize and make explicit the user’s mindflows. These methods can be used during the design of the user experience to capture and model mindflows. They are complemented by solutions to develop and manage the overall user experience, available from a growing base of established and emerging vendors.

As mobile paradigms become mainstream, traditional applications and mindful apps are borrowing from mobile fundamentals, such as responsible web design, app stores, and cloud offerings. The expansion of mobile technologies is only beginning. Almost all enterprises are expected to adopt mobile solution in the next few years, which means the evolution and innovation in mindful apps will continue for some time. And they will change the form and character of apps on other platforms, such as desktop and web.
The convergence of mobile, cloud, and desktop apps

Sam Liu of Partnerpedia explains how the world of mobile and cloud apps will converge with the world of desktop apps.

*Interview conducted by Vinod Baya and Bo Parker*

**PwC: Sam, can you tell us a bit about Partnerpedia and what problem you are solving for your customers?**

**SL:** Sure. Partnerpedia is a mobile app management vendor. We offer a software-as-a-service [SaaS] solution to help enterprises build and manage their app stores as part of their mobile, BYOD [bring your own device], or consumerization of IT [CoIT] efforts. We enable private internal app stores as well as the creation of a private-label external-facing app store.

With the rising requests for mobile apps, a common concern in IT is the control and protection of a company’s assets. It’s not much different from the days when the Internet first became popular and there were concerns about opening up the corporate network. There’s a lot of focus around security and how to lock things down. That is where we started.

The difference today is that we see a shift in attitude—from just controlling security to determining how to make the users much more productive and in a way that increases the company’s top line or reduces operating costs. The mindset has shifted a lot in just the past 12 months.

**PwC: What is the future of app store solutions?**

**SL:** Going forward, the app store paradigm should not be limited to just mobile apps. An app store is an excellent way for users to find and access an app, whether it’s a mobile or a desktop or a...
cloud application. I think there will be a convergence, where the app stores of today will evolve into a converged system to manage apps on all devices.

We see such convergence today, especially with large enterprises. They distribute applications to users either through an intranet portal that doesn’t work on a mobile device, or through FTP or some kind of heavy IT involvement such as CMDB [configuration management database] systems. That is a big hit on productivity. For example, one of our customers says app distribution could take about eight hours total turnaround time. With an enterprise app store approach, that turnaround is down to minutes.

**PwC: If apps are evolving in the manner you describe, what is the future of app stores?**

**SL:** Ultimately I think the enterprise app store will replace traditional intranets and portals. Intranets and portals were a way for users to discover and access content and apps. As intranets grew, they became pretty cumbersome, so they have had limited impact. App stores are evolving to become the window into all work, thereby replacing traditional intranets, which have largely remained static.

The other aspect of the future is the centralized tracking and management of licenses. If your app is procured through a third party, you likely have a licensing arrangement. Our system helps track the licenses of mobile apps and consolidates the auditing and reporting of licenses to a point where an enterprise can reclaim it. If somebody leaves the company, an enterprise can pull back the license and reassign it. Companies want these capabilities across the board—mobile and desktop environments. Many companies have a hard time tracking reclaimed licenses in the desktop world. The app store management environment will evolve to the centralized tracking and reporting of licenses.

**PwC: So what do you feel is the future of enterprise applications?**

**SL:** The definition of the app has morphed from the traditional definition of being a native app on the device. Today we see the term app applied to much broader entities; it could be content, a document, or a service request. What is common is that they are represented by that app icon we’re all familiar with: an action that needs to get done. This is good, because what users care about is getting something done.

The other change we are seeing is the use of devices. Whereas earlier you started and ended an app on the same device, today you might start a task on your mobile device and finish on your desktop, or vice versa.

**PwC: How are mobile apps different from desktop applications?**

**SL:** Most traditional enterprise applications are monolithic. They are applications that can do all sorts of things, just like a Swiss army knife. With mobile apps, you rescope and redesign into smaller, bite-sized functions.

**PwC: In narrowing the scope of individual apps, you have a lot of apps. Are you seeing challenges with fragmentation?**

**SL:** For now, not yet. The volume of mobile apps in the enterprise is not large enough to be an issue yet. Over time, it will be an issue, and we are focused on including features in our product to alleviate that pain. It comes down to the app store design—the most popular apps will bubble to the top.

**PwC: Most enterprises deliver a standard PC image with the applications you as an employee are expected to use and an implicit sense that you wouldn’t need anything else. App stores surely challenge that assumption. What is the impact on IT operations?**

**SL:** Indeed, the role of IT is impacted. The past has been much more of a top-down model of application selection and distribution. Interaction with users was limited to surveys or the collection of user feedback that IT would interpret when it was ready.
A new paradigm is emerging that is much more collaborative. IT should understand that users may know—better than IT does—what app is best for them. Or, users often will learn about a new app before IT does. So there needs to be a feedback loop to let IT know, “Here are some new apps that users think are better.” Indeed there will be a qualification process to make sure the new apps meet whatever corporate standards there are.

**PwC: What advice do you give your customers?**

**SL:** We advise customers: Don’t get too fancy too quick. Don’t worry about trying to put too many apps in a store too quick. Rather, focus on things that will be truly useful to a set of users. Also, when you roll out, you don’t need to roll out enterprise-wide. Roll it out to a finite group of people, do a pilot, collect feedback, fix any issues, and then distribute broadly.

**PwC: Do you think the tablet form factor is having a disruptive influence on the interest in enterprise app stores?**

**SL:** I think so. When we first started with the consumerization of IT, businesses thought they would do apps designed just for their mobile workforce, such as people in sales, the field force, and others. That’s definitely a no-brainer. But now with other computing devices such as tablets, so much more can be done more efficiently just on that form factor—even if there is a corresponding application sitting on the desktop.

Tablets are definitely a disruptor. There is literally the potential to replace a lot of the desktop-based applications and make work more efficient—even for non-mobile workers.
“Tablets are definitely a disruptor. There is literally the potential to replace a lot of the desktop-based applications and make work more efficient—even for non-mobile workers.”
Integration-ready applications

Pat Garrehy of Rootstock Software forecasts how integration-ready applications will enable users to create their own interfaces to fit their work.

Interview conducted by Vinod Baya and Bo Parker

Pat Garrehy

Pat Garrehy is the founder, president, and CEO of Rootstock Software and has an extensive background as a software visionary, architect, and engineer.

PwC: So you have been in the enterprise applications market for about four decades. What is new today?

PG: Indeed, I’ve been through many technology shifts—mainframes, minicomputers, microcomputers, client/server and, now, the cloud. In every single technology shift, one thing has stayed true. Customers want all the functionality they’ve enjoyed before, they want more of it, they want it faster, they want it cheaper, and they want it easier to use.

The functionality of the core packages is by and large the same, but the technologies in use are new. For instance, today, things are mobile, which is a strong pull for new features and use cases. There is also talk about social, which means that companies want to be more collaborative and more open with their vendors and their customers. Bottom line: mobile and collaborative features must be in the software because people are getting accustomed to them.

There is another new challenge. In the next 10 years, customers will hook to much more than just their own financial systems. With our solution, for example, they will need to hook into the corporate financial system. They will also need to hook to a number of quality control systems as well as to a variety of time and attendance systems.

On the AppExchange platform, they ask all the developers to develop in a certain way so solutions are more conducive to integration. You just cannot anticipate who will integrate to whom. Therefore, you must do more in your...
development than simply create APIs [application programming interfaces]. You must “harden your objects.”

PwC: What does that mean?
PG: It means all the business logic is on the back end and every single file or table you develop is hardened and has the potential to be called by some other application. It means you have exposed all your fields in a manner that is easily accessible but the integrity of that particular table is maintained.

It’s being done and, most importantly, it works. For example, when we hook to a system on the same platform, we can expect that objects in the other system are hardened and they’re easy to access. We also know that we can easily add fields to their screens [interfaces] and they can add fields to our screens. These kinds of things are part of the new development paradigm that is defined around ease of integrations.

PwC: Software packages are large. Do you choose what is hardened in this way and what is not?
PG: That’s exactly what we do. For example, when we sell our sales order entry header and sales order entry line. We’ll harden our purchase order, our engineering item, our bill of materials, and our project master file. Right now, we’re in the process of hardening our work order. By the time we are done, we will have hardened more than 75 percent of our objects.

For the most part, you harden those things that are more likely to be called by somebody else. On the other hand, we do not need to harden the control record; no one needs to call a control record. Importantly, hardening is not a need just for other software vendors. It is invaluable for the end customers. When customers want to build their ancillary apps and do their own customization on top of our system, the same principle holds.

For example, we have our own RMA [return merchandise authorization] module. We do it a certain way and it’s tailored to our warranty system. However, customers might have their own RMA module that has a lot of their cost accounting built into the module and they would not want to lose that. They can and should be able to use their RMA module with their methods of cost accounting, yet they can access the objects in our system to make sure the supply-demand balance stays correct. That’s the kind of thing that is going on and will go on more in the future. You need to build for that.

PwC: How are mobile trends influencing your strategies?
PG: I believe mobile trends are accelerating the push toward cloud [software as a service], as mobile development and usage are better suited for the cloud architecture. There are use cases we don’t even know about that will push people to embrace cloud technology.

Mobile platforms are creating new energy around the user interface. We must really think about how the app is going to be used, which will be different from how it was or will be used on the desktop. This difference in usage is the other reason we are hardening the objects, giving users the freedom to create their own interfaces. Since there is integrity of logic, end customers can slap on another screen [interface] as best fits their work.

PwC: What is the impact of such developments on the design of your solutions?
PG: While the roles and needs may differ, they are all connected to the same ERP system. For example, if you look at a manufacturing organization, the receiving clerk, the person in the stock room, and the worker on the production floor usually have simple but specific needs to process an order, forward a receipt, deal with expiration dates, and so on.

Then, go to the other end of the spectrum, the C-level person who has analytical needs. That person probably has a large screen and is thinking in 15 different dimensions, because that is how he or she runs the business. As you go down from the C-level to the managers, they may have similar needs but fewer items on their desk.

Everybody had the same user interface 20 years ago. That is definitely different now. In the future, there will be Rootstock’s complex screen and there will be Rootstock’s simple screen. Customers can take their favorite third-party app, create new interfaces, and put them on top of ours and other applications. Users will develop their own interfaces in effect.

Five years from now, there will be tools for a power user who understands how work is flowing across the various roles and individuals, and who needs specific information to do his or her job more effectively. I believe those tools will superimpose on packages like ours.

“In every single technology shift, one thing has stayed true. Customers want all the functionality they’ve enjoyed before, they want more of it, they want it faster, they want it cheaper, and they want it easier to use.”
The mindful CIO

Extend your core applications, data, and infrastructure to better serve the cognitive processes of knowledge workers.

By Bud Mathaisel and Vinod Baya

Blending human and software intelligence is the new territory for enterprise applications. By providing support for human cognitive processes, future enterprise apps will engage humans as an integral part of the business process of interest. (See Figure 1.) PwC calls such applications mindful apps.

As discussed in the article, “The future of enterprise apps: Moving beyond workflows to mindflows,” on page 06, mindful apps model human thinking patterns as part of the business process, use context, and deliver intelligence in the moment to augment the capacity of employees to add value through knowledge work. Mindful apps interact and present information based on human thinking patterns. This integration of the human element is in contrast to much of the history of applications, which has largely limited or eliminated human involvement in business processes in pursuit of the automation of end-to-end processes.

CIOs have spent decades putting in place the core applications, data, and infrastructure to serve the enterprise and its users. Leveraging that core certainly has ongoing advantages, and the core will continue to evolve. Mindful apps extend the core to new use cases and allow CIOs to find new areas of value creation.

Many characteristics differentiate mindful apps from traditional apps. Some key differences include:

• Rather than optimizing the work of a group of people as traditional applications do, mindful apps optimize the work of individuals by focusing on the role of thinking in their work.

• Rather than embracing a scripted flow to a deterministic transaction, mindful apps support exploratory dialogues associated with cognitively complex decision making under uncertainty.

• Rather than prescribing a single best path to an outcome, mindful apps support the multiple paths necessary for exploratory work.

Mindful apps borrow many characteristics from the emerging capabilities of mobile apps. (See Table 1.) “Mobile apps will play a big role in this requirement [real-time interfaces and insights that fit with how work is
done], as they allow me to integrate data and context with the workflow,” says Isaac Sacolick, CIO of McGraw Hill Construction. Therefore, the design and development of mindful apps build on methods and technologies that enterprises may be using already in their mobile apps effort. The article, “Technologies that enable mindful apps,” on page 28 describes many of these methods and technologies.

Workflows have been a foundational concept in traditional applications for automating business processes. The foundational concept for mindful apps is what PwC calls *mindflows*. Mindflows are goal-driven thinking patterns—such as comparing, evaluating, and summarizing—used by anyone engaged in complex analysis and decision making. The journey to the goal might have many potential paths and usually unfolds in iterative divergence-convergence patterns. (See the section “Surfacing mindflows” later in this article.)

The opportunities for mindful apps are everywhere. A significant portion of enterprise work is unstructured, ad hoc, nonstandardized, or variable—in other words, knowledge work performed under variable degrees.

Table 1: The characteristics defining mindful apps borrow a great deal from the characteristics of mobile apps, although not all mindful apps in the future will be used on a mobile device.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Traditional applications</th>
<th>Mobile apps</th>
<th>Future apps (mindful apps)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scope</strong></td>
<td>Large scope, process oriented</td>
<td>Bite-sized, goal-driven services</td>
<td>Cognitively manageable scope</td>
</tr>
<tr>
<td><strong>User interface</strong></td>
<td>Users need training to use</td>
<td>Simpler interfaces</td>
<td>Users learn intuitively</td>
</tr>
<tr>
<td><strong>Focus of design</strong></td>
<td>Optimized for groups</td>
<td>Optimized for persona/person</td>
<td>Optimized for individuals and harness power of the group</td>
</tr>
<tr>
<td><strong>Driver of experience</strong></td>
<td>Workflow driven</td>
<td>Goal, context driven</td>
<td>Mindflow driven</td>
</tr>
<tr>
<td><strong>Relation to analytics</strong></td>
<td>Separate analytics</td>
<td>Integrated analytics</td>
<td>Integrated and predictive analytics</td>
</tr>
<tr>
<td><strong>Delivery model</strong></td>
<td>Dominated by on-premise delivery</td>
<td>Driving adoption of SaaS</td>
<td>SaaS as the dominant delivery</td>
</tr>
<tr>
<td><strong>Management model</strong></td>
<td>Configuration management database (CMDB)-based model</td>
<td>App store model</td>
<td>Will evolve from app store-like model</td>
</tr>
<tr>
<td><strong>Timeliness of data and analysis</strong></td>
<td>Often delayed reaction</td>
<td>In the moment</td>
<td>In the moment</td>
</tr>
</tbody>
</table>
of uncertainty. Consider HR, as an example. Most activities for hiring, onboarding, coaching, and performance evaluation are bathed in information complexity and knowledge intensity. Mindful apps can help.

**How to design and develop mindful apps**

Designing, developing, and deploying mindful apps are a shift from writing detailed specs, buying, configuring, and deploying a traditional enterprise application. Although certain mindful apps could be purchased as a complete tool from IT applications vendors, CIOs should expect some need for custom development, given the tight relation of mindful apps to persona or individuals in specific roles. Such customization is not unlike the custom mobile app development already under way at many enterprises.

**Designing mindful apps:**

**The key role of user experience**

There is no established template for building mindful apps, so understanding the guiding principles for design is crucial. The user experience is of singular importance. “The user experience is the key underappreciated enterprise critical success factor,” says Bill Murphy, CTO of Blackstone, an alternative asset management company. Because mindful apps are personal, about the thinking self, and about accomplishing ad hoc knowledge work, the user experience provides a holistic way to understand and address all of the concerns together at the design stage. In PwC’s experience, and as shown in Figure 2, four principles are the keys to developing winning user experiences:

- **Concentrate on user-centric design:** Present the user with the right information at the right time, in
Focus on finding solutions to critical questions and presenting the answers in a compelling and engaging manner. Putting the user in the center produces information and data visualizations that are contextual and therefore actionable and timely.

- **Design for a reason:** The app’s goals should be explicit, definable, and measurable. By understanding the user’s goals, developers can design an application that shortens the time to complete the highest priority tasks.

- **Keep it simple:** Focus on the highest priority at the moment, remove distractions, and introduce complexity only when necessary and value creating. Incorporate ongoing user feedback to keep making the experience simpler.

- **Always validate:** Across all phases of development, validate assumptions, interfaces, and interactions with users, so the designs remain aligned with how users work and even how that might be changing.

The simplicity of the interface does not mean there is no complexity. The complexity in the app is abstracted to other layers, such as the mindflows, the workflows, business logic, predictive or real-time analytics models, the architecture, and other elements. The objective is to hide the complexity behind the scenes to limit the cognitive load on the user and to integrate the human-computer dialogue as a flexible interaction for better decisions and results.

**Surfacing mindflows**

Mindflows are the foundational concept for mindful apps, and there are many approaches to surfacing them. SAP uses design-thinking methods to understand the mindset of its users. Oracle uses digital body language to capture, understand, and predict what is going on in a user’s mind.

Many organizations use multiday workshops to gather the insights and raw materials for mindflows. PwC conducts workshops as a start to the design activity to understand the goals and externalize the thinking patterns. Workshops can have different emphases. A discovery workshop focuses on solving complex user interaction scenarios and results in mindflows, use cases, and rough mockups. An ideation workshop focuses on “next-generation” application concepts, and the outputs are user stories and rough mockups.

Sometimes the best way to understand the user’s mindflow is to think like the user. Blackstone’s Murphy relies on such a method. “The bridge between the business and an excellent solution is best provided by technologists from the product development team who are completely engrossed in the business, so they can help make those decisions and not rely on just asking somebody,” he says. “Once we understand the problems, we’re pretty confident we can solve them.”

All of these approaches externalize the thinking patterns of the user by seeking answers to questions such as: How did you get here? What information do you need now? What are you trying to understand? What will you do next? What would you like to do next in an ideal scenario? The objective is to draw out the iterative divergent-convergent flow of mind states and the information requirements that guide the movement across the states. (See Figure 3.) The result is a flow across underlying thinking patterns, such as inferring, analyzing, classifying, evaluating, comparing, summarizing,

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1 See the interview, “User mindsets are driving the future of applications,” on page 20.

2 See the interview, “Using digital body language to transform applications,” on page 24.
Once enterprises support complex decision making by using mindful apps, organizational and individual learning will occur. This learning will transform the decision environment and how work is done, requiring a rapid response by the development team for the app to continue to be useful. App developers don’t have the luxury of long lead times for design, or an expectation of app longevity without constant tuning. Users will quickly recognize when the data, analytics, or patterns become stale.

The good news is that apps design and development can harness application programming interfaces (APIs) and agile capabilities, such as DevOps, which have emerged to support rapid, iterative development and deployment with scale. “Agile methods are a core aspect of our development methodology. We’ve introduced agile principles and methods to our businesspeople, for example, and they think about their business needs and how to prioritize requirements using agile,” says McGraw Hill Construction’s Sacolick.

The opportunities for mindful apps are everywhere. A significant portion of enterprise work is unstructured, ad hoc, nonstandardized, or variable—in other words, knowledge work performed under variable degrees of uncertainty.

and others. These patterns inform the design of the software. Focusing on pattern means the software does not need to identify and model all the permutations of the flow. Good software design will adapt to new situations as well as discover flows over time.

Most businesses perform many activities that can be adapted for the design of mindful apps because of the similarities in approaches and outputs. Among these are ideation, 360-degree information gathering, convergence of themes, divergence based on testing themes with users, iterations to new themes, conclusions, prototypes, feedback, and others.

Developing mindful apps
Mindful apps can usually be rolled out in weeks rather than months or years and then incrementally refined or made feature rich over time. Much like mobile apps, they typically target a focused, well-scoped, goal-driven activity. For developers of mindful apps, rapid development and deployment capabilities are essential. Apps should start small and evolve to include the activities and flows they support.

Figure 3: To make mindflows explicit is to capture the iterative divergence-convergence patterns across mind states and the information requirements that guide the movement across the states.
Another key difference from the desktop is that instead of the user adapting to the app, the app adapts to the user. “Everybody had the same user interface 20 years ago. That is definitely different now,” Garrehy says. “Customers can take their favorite third-party app, create new interfaces, and put them on top of ours and other applications. Users will develop their own interfaces in effect.”

So although developers will design the ideal interface, it needs to have an adequate level of personalization features to be widely useful.

Another challenge is to balance the smaller screen size with the rapidly growing data pertinent to the task at hand. “Mobile devices offer smaller screen sizes, so the presentation of information should be deeply thought out ahead of time and not left to users to create on their own,” McGraw Hill Construction’s Sacolick says.

User interfaces and mobile apps
While not all mindful apps are mobile, many are and more will be. Mobile apps are introducing new expectations around user interfaces. “Mobile platforms are creating new energy around the user interface,” says Pat Garrehy, founder, president, and CEO of Rootstock Software, which develops cloud-based enterprise resource planning (ERP) and supply chain software. This shift is not a simple case of rethinking or redeploying the desktop interface to the mobile platform. “We must really think about how the app is going to be used, which will be different from how it was or will be used on the desktop,” he adds. Externalized mindflows are a resource in this regard and can be a key input into interface design. For example, an interface for the thinking patterns of comparing will differ from those for the thinking patterns of evaluating or summarizing.
Implications for IT strategy
The rise of mindful apps challenges the prevailing operating models of IT organizations. Many organizations are reactive and address new requests by starting a project that ends after some time and that releases the resources to work on other projects. This approach inherently breeds short-term thinking.

In contrast, mindful apps evolve over time. Rather than a big bang implementation, they start small and grow in capability and impact. Murphy operates his organization as a collection of product-focused teams. “The product-focused commercial teams have much more incentive to focus on the long term and to treat their solutions as a living, breathing thing,” he explains. “My goal here really has been to orientate us as a product-focused organization to make the long-term investments. Sometimes that’s painful on the prioritization side. But when you do it, the benefits start to add up once you get the momentum going.”

The impact is not limited to the operating model. IT architecture also changes for the better. “If we could build the perfect blue-sky architecture, there would be a complete decoupling among the workflows, the data services, and the user interfaces,” Sacolick says. The objective is to be ready to tap an ever-increasing list of data sources, as well as to individualize the interfaces to the persona or individuals. “Then I would have the freedom to source data as needed from any internal or external source. This is in essence what we are trying to do.”

Mindful apps reenergize the partnership model between IT and the business, whether it is in development or overall governance of IT systems and processes. The reality is that mindful apps will pull the IT organization deeper into how work is done, because it must engage with the mindflows. And as a result, mindful apps will provide a new avenue for collaboration. “The only way to understand buyer [or user] behavior is to look at the digital data. The only way to work with that data and get in front of the mindflows is to analyze, process, and build flows based on that digital data. We have two paths to get there: either marketing teams become more technology oriented, or IT teams become more marketing oriented,” says Steven Woods, group vice president of software development at Oracle.

Why mindful apps are truly different
Mindful apps are not intuitively tangible. They are designed to inform a thinking process, not control the process. Mindful apps are more than an extension of IT’s normal methods and toolkit. They challenge the fundamental basis of IT’s focus on precision and control. Thus, CIOs may struggle with the best path for adoption in their enterprise.

With the goal of helping CIOs think about mindful app adoption, the following sections of this article present a CIO perspective on some key questions and responses.

Aren’t mindful apps just BI with a new name?
Mindful apps are not just a variation on business intelligence (BI). Yes, the users are engaged in research-centric or knowledge-centric processes. However:

• Mindful apps do not simply provision lots of data and let users have at it. Mindful apps are explicitly designed for an outcome and a voyage of discovery informed through building insights. Mindful apps bob and weave with users as they interact with data and analytics, come to conclusions, change their data search, look at new information, eliminate obstacles, and make decisions.

• In BI, users may not find data they need. With mindful apps, users will improve the knowledge base by adding new information into the system.
A Mindful App is Designed with a Cognitively Manageable Scope. It breaks big tasks into smaller manageable experiences.

- BI focuses on generating reports and visualizations of data. Reports are an endpoint. Mindful apps embed BI capability in the service of a user goal.

- Mindful apps build on BI by facilitating an iterative, guided dialogue with the user and by taking support for thinking to a higher level.

The CIO should think of mindful apps as the logical evolution of making systems more productive for users than BI alone could accomplish.

Can’t we just apply business process reengineering to develop mindful apps? Most CIOs are familiar with business process reengineering (BPR) and have used it successfully. But they can’t just apply BPR because BPR was ideal for the big problems that are common across the enterprise and for which a common business process model is designed. Thinking is personal, dynamic, and builds by nature, and the specific outcome is unknown until the user “gets there.” Common workflows are not likely to be effective across all these thought patterns.

Each thinking role in the enterprise has different thought patterns and different issues to resolve. From users’ individual digital trails (their digital body language), a mindful approach derives the patterns of individual users’ inquiries and actions. The linear approach of BPR does not allow the iterative flexibility required for mindful apps.

Aren’t mindful apps like expert systems or knowledge management systems from more than a decade ago? It’s true, mindful apps might evoke memories of knowledge management (KM) or expert systems, both of which struggled for enterprise-wide adoption. However, there are fundamental differences between mindful apps and these earlier systems.

A mindful app is designed with a cognitively manageable scope. It breaks big tasks into smaller manageable experiences. It is therefore tractable and can be developed in weeks or months. Most expert systems and KM efforts become overwhelming because they take on the scope of the whole enterprise or an entire profession, such as medicine or law.

Mindful apps focus on intelligence in the moment—that is, the information, questions, or actions likely to be most relevant to the time, place, and circumstances of the user’s current context. In contrast, the typical KM system focuses on all contexts. Hence, KM systems become too resource-heavy, too complex to operate, and too difficult to parse in the moment.

Mindful apps separate reasoning and flow, bringing flow into the app and leaving reasoning to the human, whereas expert systems tried to model the reasoning, which is a difficult task in many use cases. Instead, mindful apps model the mindflow (the states through which a user moves while carrying out a task) and the information that causes the change of state, not the complexity of reasoning and decision making.

Because of growing digitization and the rise of cloud and mobility architectures and infrastructure, new information (such as mindflows and digital body language) is accessible to apps today. That information was not available in the past. These new facts could benefit expert systems and KM solutions, as many of them are likely to evolve in the mindful direction.
Where will the enterprise get the specialized talent for mindful apps?

Does a mindful app project require recruiting new, unproven people into an established culture? To address this question, it is helpful to separate talent into two domains: mindful app design, and mindful app development and deployment.

Talent for mindful app design. Mindful app design will require skills that might be new to IT. Design thinking requires an information decision psychology mindset that would include capabilities such as those that a user story modeler, researcher, business analyst, data scientist, visual thinker, or graphics artist would have.

Rather than thinking of these capabilities as entirely new in the abstract, it is useful for CIOs to think in relative terms, leveraging skills from roles that do exist. For example, Blackstone’s Murphy says, “I liken my designers to journalists, where the most important part of their job is to come up with the right questions so they can draw out the important problems of our user base.” Journalism is one model. It incorporates the elements of research and analysis and the ability to form and manifest user stories in compelling ways.

Marketing is another model. Marketing, especially marketing planning, relies on abilities similar to those of design thinkers: collecting and categorizing detailed information about users’ behaviors combined with the skill of interpreting the data and projecting future behavior patterns.

Research is a third model. Research groups have talent that is proficient at designing research processes (roughly akin to developing user stories), establishing hypotheses (goals), analyzing information, drawing conclusions, and documenting findings and conclusions.

Within IT itself, the talents of really good business systems analysts (BSAs) may be an excellent starting point, but with a key difference: designing a mindful app is much more data intensive, iterative, and open ended than a BSA’s usual work and work product.

Some current employees may be able to apply skills they possess but have not yet had the opportunity to use. For example, some employees’ academic backgrounds may include psychology or other valuable foundational skills.

Talent for mindful app development and deployment. For crucial IT support roles in mindful app development and deployment, these IT skills are needed:

- Agile and DevOps
- API design, management, and support
- Native development on mobile devices and using HTML5
- Experience in big data and analytics solutions, such as Hadoop, HANA, and Fusion
- The ability to ensure that the apps meet the requisite regulatory compliance, cybersecurity, disaster planning and recovery, business continuity, and financial controls

CIOs can help the enterprise decide whether to improve the skills of current staff or to bring talent from outside. If IT leads the mindful app project, a rotation into IT from another enterprise group is always beneficial and usually welcome. The previous lists are guidelines for helping that assessment.
The CIO takeaways for mindful app leadership

Thinking is the essence of mindful apps. Henry Ford famously said, “Thinking is hard work, and that is why so few people do it.” It is hard work, so one of the important mindful apps design principles is to simplify complex thinking processes by decomposing them into smaller, manageable thinking patterns—a feat achieved by defining the mindflows that make up any cognitive activity. By decomposing a thoughtful activity into bite-sized experiences, an app can target each stage with information and analytics that are a better fit for that stage of the thinking process.

The growing digitization of the enterprise and rapid innovations in cloud, mobile, analytics, and social technologies present a key opportunity for CIOs to invest in the talent, technologies, and design and development methodologies needed to be successful with mindful apps. There is much to learn, as blending human cognitive processes and software intelligence with enterprise business processes is a brand new field of endeavor, and few IT organizations have experience with it. But the pursuit of excellence in developing this capability will pay off in ways that IT’s long-standing role in promoting productivity never has. It will impact the effectiveness of decisions, reasoning, analysis, and all nature of knowledge work that are so commonplace and crucial to any enterprise’s operations in all of its functions.

CIOs have an excellent perspective on the entire enterprise, its current information capabilities, and its future information plans. CIOs have learned how to codify complex decision making in enterprise applications and can leverage that experience to engage with mindful apps. In particular, CIOs should:

• Create a vision of what their organization could achieve if the apps had access to the mindflows of key roles.

• Rethink the ongoing mobile app investments in light of the characteristics of mindful apps, and steer the development in a more mindful direction.

• Recognize that the user experience can provide a competitive advantage, and bring in necessary talent from the outside or provide a career path to those already in the organization.

• Establish a taxonomy of knowledge work tasks in the enterprise suitable for mindful apps. Roles that have a high cognitive load, high enterprise impact, and occur frequently are good candidates.

• Understand and champion new design methods for apps that surface mindflows. Organizing and attending workshops that put users at the center of the experience is one of the ways to do so.

The opportunity to advance enterprise thinking with mindful app support is big and highlights the next leap in bringing enterprise applications that have greater value to businesses. The outlook for CIOs, as they demonstrate mindful leadership, is excellent.

“I liken my designers to journalists, where the most important part of their job is to come up with the right questions so they can draw out the important problems of our user base.” —Bill Murphy, Blackstone
The opportunity to advance enterprise thinking with mindful app support is big and highlights the next leap in bringing enterprise applications that have greater value to businesses.

The outlook for CIOs is excellent.
Why apps are adjusting to the user

Isaac Sacolick of McGraw Hill Construction describes how personalized apps create business value.

*Interview conducted by Vinod Baya and Bo Parker*

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**PwC: Isaac, can you please tell us about your business and your role there?**

**IS:** Sure. I work for McGraw Hill Construction as the business unit CIO. We provide essential data, news, insights, and intelligence to better inform construction professionals’ decisions and strengthen their market position. Our primary customers include general contractors [GC] and building product manufacturers.

Historically our products were in print format. More than a decade ago, we started providing our content in digital form. That transformation seeded our data business. During the past few years, we have been transforming from a data business to an intelligence, analytics, and insights business that provides intelligence on relationships, such as which GCs and architects owners work with, and forecasts on industry trends. Our offerings help businesses in the construction ecosystem size market opportunities, target and build relationships, and optimize their sales activity. Dodge, which is our key database of construction project information, has more than 5,000 project updates reported each day, so the data stays fresh and actionable for all participants in the ecosystem.

Most of my responsibility is for the customer-facing products and our internal operations—so, the systems for business intelligence, product delivery, content management, CRM [customer relationship management], lead generation, and others. Over the last three years we’ve established a global agile software delivery practice.
The future of enterprise apps: Moving beyond workflows to mindflows

and new data technology platforms that have enabled us to launch five new products. I spend very little of my time on things such as data centers and infrastructure, which our corporate IT organization provides to us as a managed shared service.

PwC: What are your key priorities today as they relate to the future of enterprise applications in McGraw Hill Construction?

IS: Our strategic priorities are to continue moving beyond pure data services. Reporting and analytics are a big part of that, as well as applications that integrate analytics within the context of how our internal and external users work. For example, our sales force uses our solutions in the context of selling. If they are targeting a manufacturer or general contractor, the salespeople need to know how the target is performing, the target’s past and future contracts, market share, lost bids, and so on. We deliver some of that information to them.

The reality is that our field sales force does not spend much time at desks researching and absorbing information, because much of their time is out in the field. They need real-time interfaces and insights that fit into how and where they do their work.

Another key priority is to ensure that all departments have the ability to leverage data from our business systems (CRM, financial, marketing), operational data, and proprietary Dodge data to discover insights and enable smarter decision making. We’ve done that by rolling out internal BI [business intelligence] tools and allowing individuals to develop their own dashboards. I’m fairly passionate around data-driven organizations, self-service BI, and agile practices, and I cover it in my blog Social, Agile, and Transformation.1

PwC: Are there challenges you are addressing as you advance on this vision?

IS: One challenge is that our legacy systems were not developed with the anticipation of sharing the information broadly across the enterprise. Integrating these sources for both our internal and external customers is ongoing, and we’ve started by developing APIs [application programming interfaces] to our primary databases and content repositories. The APIs have enabled us to deliver multiple web and mobile products in record time and ensure consistent experiences in using our data.

A growing challenge today is creating mobile apps that balance the need for easy navigation with the continuous growth in data that is highly relevant to the job. Mobile devices offer smaller screen sizes, so the presentation of information should be deeply thought out ahead of time and not left to users to create on their own.

Also, the improving economics of big data is forcing everybody to get ahead of the curve on using large amounts of data as a source of distinctiveness—or risk becoming less competitive. We now are living in a world where if you fall too far behind, you’ll have a hard time catching up.

PwC: How have your methods of application design and development changed over time, and how are they evolving?

IS: Agile methods are a core aspect of our development methodology. Everything we do here is based on agile. We’ve introduced agile principles and methods to our businesspeople, for example, and they think about their business needs and how to prioritize requirements using agile. When we develop the user stories, we use them to surface workflows, describe different user personas, and establish acceptance criteria.

We have also followed many technology best practices employed more commonly by software and SaaS [software-as-a-service] businesses. We’ve developed multiple products and applications efficiently by developing APIs. In our largest products, we automate QA regression tests to ensure that we can continue to add features and maintain testing durations. We analyze product usage to help improve products and prioritize enhancements.

PwC: Can you give us an example of an app that supports users in their work?

IS: Sure. Dodge BidPro is our product for smaller contractors. It provides targeted leads to contractors. This product is an in-the-office as well as

1 http://blogs.starcio.com

“The reality is that our sales force does not spend much time at desks researching and absorbing information, because much of their time is out in the field. They need real-time interfaces and insights that fit into how and where they do their work.”
an on-the-go solution for finding, qualifying, estimating, and bidding on projects. Smaller contractors are unique and have particular needs. They tend to work on certain types of structures and in certain regions of the country. They also tend to work on fewer projects simultaneously. These are people who will be at their desk for a very small portion of their day.

On the other end, our Dodge BI products can be leveraged by the strategic, planning, and business development people at larger GCs and building product manufacturers. So if they are exploring new market opportunities, these dashboard tools provide insights on sizing markets; for example, knowing regionally where hospitals are being planned. They can then use the BuildShare to target owners developing hospitals and develop relationships with them.

So our challenge was how to get the right mix of information to the users across multiple channels—such as mobile, web, e-mail, APIs, and printouts—so as to optimize the amount of time they can spend collaborating, bidding, and finding their future work. We studied their contexts and defined a simple interactive experience that can be carried out in short bursts of time.

We provide features that map to the manner in which they do their work. For example, it allows them to save searches; track projects; get leads based on location, trade, or project specialty profile; qualify projects; get alerts on changes; receive information on who is bidding; and so on.

**PwC: Are they also collaborating with others?**

**IS:** Indeed. BidPro allows contractors to track, share, and collaborate on bids with other subcontractors. Timeliness of information is very important. If you’re a GC and there’s a deadline to respond to a bid, a day matters a lot as the GC must reach out to subs [subcontractors] and get that process started. If you’re a sub, the GC will alert you about a project and give you a deadline. The app enables the sharing of targeted information, simplifies navigation, and tunes the overall user experience to the constraints of less time and less screen space even while processing more and more information.

**PwC: How is this different from what you had before?**

**IS:** Our legacy products presented one experience to all user types, the big and the small contractors. That worked for us, because we developed one product and we sold one product. But it was problematic for users. In the legacy product, the GC had to use search interfaces that were big and complicated. It was derivative of a world where the largest contractors were using many fields [search categories] to find specific projects from a long list. This complexity was a bad fit for the smaller contractors, who generally track only a few projects at a time.

The [app] products today are personalized to the user role. BidPro has a very simple user interface for the smaller contractors. The Dodge Global Network is a richer interface for the larger GCs and allows them to do a lot more configuration and share information with multiple users. Our Dodge BI products are designed to provide strategic information leveraging multiple years of historic data; market forecasts that we develop; relationships among owners, contractors, and architects that we expose; and detailed product information that we extract from building plans and specifications.

**PwC: How do you personalize for the user when the data sources are common?**

**IS:** If we could build the perfect blue-sky architecture, there would be a complete decoupling among the workflows, the data services, and the user interfaces. Then I would have the freedom to source data as needed from any internal or external source. This is in essence what we are trying to do.

We have an API strategy that we’ve successfully used to build internal products. We’ve designed the APIs so that customers can tap into or buy an API—buy our data as a service through the APIs. They will have the flexibility to integrate our data and intelligence with any app able to access our APIs. That’s a different service model for us and a different integration model for our customers.
The future of enterprise apps: Moving beyond workflows to mindflows
Elevating user experience

Bill Murphy of Blackstone explains why the user experience is an underappreciated critical success factor.

**Interview conducted by Vinod Baya and Bo Parker**

**PwC: Bill, can you please tell us about your role and responsibilities at Blackstone?**

**BM: I came to Blackstone about two years ago to lead the technology team after leading product and technology at Capital IQ for 11 years. My strategy has been to take a product-like approach and architect a transformation that positions our team to be proactive and to focus on creating long-term efficiencies for our professionals who are doing everything from private equity, real estate investing, and hedge fund solutions, to our credit business. We're the largest alternative asset manager in the world, which brings unique opportunities to use technology effectively.

As you can expect, we face some information challenges and workflow challenges to keep our professionals as productive as they can be. Our overall goal comes down to creating transparency inside of Blackstone as well as with our investors in ways that haven’t been typical in the alternative asset management world.

**PwC: How do you tackle these challenges?**

**BM: We do that in how we design the user experience to handle information. The only way to truly design the right experience is to be in the middle of the business, understand all the problems, and then you can work to create the right solutions. I equate the process to be like one of those magic eye paintings, where you stare at a painting and then suddenly the picture comes into focus. You don’t necessarily know what the solution is going to look like, but if you concentrate and focus on it, a clear picture usually arises.**
“The technologies that succeed are the ones that figure out how to tailor the experience without the user knowing about it.”

That’s my view of building systems for our industry. You need to put the right information or a lot of information in front of the right people in a way that makes it easy for them to consume it and come up with the new opportunities, the new products, and the new creative ways to invest—to see something that others haven’t seen yet.

In terms of use cases for value add, we aim to take away as much stress as possible from the easy stuff, by automating the routine and mundane actions, and give users more time to focus on the higher-end pieces of what they need to do.

**PwC:** **How does this view impact the future of the applications you are investing in?**

**BM:** My view is that in enterprise IT, applications are going to win every time. The infrastructure stuff is just a means to an end. As soon as a great SaaS (software-as-a-service) application emerges in a space, it is extremely disruptive and drives out the legacy solutions eventually. So, we’re investing in apps that meet our needs and make us more efficient, and we’re integrating them together to unify the user experience as much as possible.

Also, we build mainly web applications, and our strategy has been to build them in a very touch-friendly way, so they would be very usable on a phone or a tablet. We are doing responsive design, building web applications in ways that render very well to phones and tablets.

**PwC:** **Enterprise applications have a long history. What characteristics are you focused on for the future? Have design principles evolved over time?**

**BM:** Absolutely. We see a trend that the apps people use at home generally are much more usable than the enterprise applications they have at work.

The user experience is the key underappreciated enterprise critical success factor. We have been kind of manically focused on making that user experience world class in our web apps. It is really about what can one do to provide information in an easy-to-digest fashion and take action on that information in as little time as possible, because every minute of our professionals’ time is valuable.

Another aspect of making the user experience fantastic is personalizing it to the user type. I think the technologies that fail are the ones that put the onus of personalization on the individual user. The technologies that succeed are the ones that figure out how to tailor the experience without the user knowing about it.

I also think that users are more and more unwilling to spend the time to learn your system. Therefore, you really need to strive to create the experience they want to have without working at it.

**PwC:** **So in some sense what you’re saying is that instead of the user adapting to the app, the app adapts to the user?**

**BM:** Right. It adapts to the user by being so well designed that it just feels right and doesn’t cause a major disruption from their existing work processes, unless it eliminates the work, of course.

**PwC:** **Where are you seeing new opportunities to deploy apps?**

**BM:** Think about Wayne Gretzky. He was the best hockey player ever, because he didn’t skate to where the puck was; he skated to where the puck was going to be. One significant opportunity I see is to build applications that anticipate two steps ahead where the user will be and provide support accordingly—almost like augmenting users with the best possible personal assistant who is with them all the time. Google Now is an example of that in the consumer space and a good proxy for the trend in apps that we are all going to be benefiting from in the next 10 years.

If we can use technology to do that in the enterprise, we will have achieved a lot of productivity gains.

**PwC:** **You said the user experience is the most underappreciated critical success factor. How do you get your teams to focus on the user experience?**

**BM:** If you think about all the great innovations, they’re typically from people who can understand their problem set so deeply that they can then reimagine and think differently and not accept the status quo. So a good design principle is to focus on the problems at hand, understand them in excruciating detail, and extrapolate them out to the right solutions using the latest in technology.
“A good design principle is to focus on the problems at hand, understand them in excruciating detail, and extrapolate them out to the right solutions using the latest in technology.”

The bridge between the business and an excellent solution is best provided by technologists from the product development team who are completely engrossed in the business, so they can help make those decisions and not rely on just asking somebody.

I liken my designers to journalists, where the most important part of their job is to come up with the right questions so they can draw out the important problems of our user base. Once we understand the problems, we’re pretty confident we can solve them. I think most of the subpar solutions in the world come from poorly designed problem sets.

**PwC: Do you use any formal methodology?**

**BM:** Our methodology is to communicate early and often and be with our users every step of the way, so we can design the solution that results in the best user experience. Because there are so many different methodologies, we try to cherry-pick them through the life cycle. For instance, we pick the right methods from agile to help us be iterative, the right methods from waterfall to manage the project based on the resource constraints, and the lessons from the other methodologies. I don’t think there is one right methodology. It’s about adapting a collection of methods to your culture and the tools at hand to create the right experience. Basically, use a common sense approach all along the way.

We have an open forum design process, where everybody gets in a room to talk about the problems and then the proposed solutions. My strategy has been to seed a best-idea-wins culture. There’s not a lot of hierarchy, and dictatorial behaviors are really frowned upon.

Also, all the technology trends aside, effective change management for the users is core to our methodology. An effective product that’s delightful enough for users to make them want to change and a change management process to make that change without pain are the two critical success factors to getting any ROI [return on investment] out of these new technologies.

**PwC: Given what you have told us, what is the right operating model for IT in the future?**

**BM:** I think the right model of the future will be inspired by product-focused commercial teams. Much of the internal IT operating model today is reactive. Ask any business user, what should we do today? The answer usually is, well just fix my report, or just fix this, or just fix that. And you just die of 1,000 paper cuts.

At the end of the day, the reactive operating model is the biggest thing that internal technology teams suffer from versus product-focused commercial enterprises. The product-focused commercial teams have much more incentive to focus on the long term and to treat their solutions as a living, breathing thing.

In contrast, internal IT teams view their solutions as projects—not products. That leads to bad short-term-focused decisions and a lack of long-term investment. My goal here really has been to orientate us as a product-focused organization to make the long-term investments. Sometimes that’s painful on the prioritization side. But when you do it, the benefits really start to add up once you get the momentum going.
“Users are more and more unwilling to spend the time to learn your system.”
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Subtext

**Mindful apps**  Mindful apps model human thinking as part of the business process of interest, use context, and deliver intelligence in the moment to augment the capacity of employees to conduct knowledge work. Mindful apps present information to users based on thinking patterns.

**Mindflows**  Mindflows are goal-driven thinking patterns—such as comparing, evaluating, and summarizing—used by anyone engaged in complex analysis and decision making. The journey to the goal potentially has many paths and unfolds in iterative divergence-convergence patterns.

**Future of enterprise applications**  The future of enterprise apps is to blend human and software intelligence by extending beyond workflows to mindflows and thereby bring human thinking (and humans) into the enterprise business process that is supported by apps.