technologyforecast

Decoding innovation's DNA

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pwc

Is innovation the result of inscrutable, opaque genius, or can innovation be treated as an end-to-end process subject to performance optimization by adopting proven methods?

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Message from the editor

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Chip Kelly is the head coach of the University of Oregon Ducks football team, which came close to winning the Bowl Championship Series (BCS) championship game in January, losing to Auburn University by 5 points. Playing for the national championship was something Oregon had never done before. Kelly first gained national attention in 2009 with an upset of the then No. 5 ranked University of Southern California Trojans. That season he was the first Pacific-10 rookie coach ever to win an outright conference championship. Oregon also became the first Pacific-10 team to win a conference title by two games since the University of Washington accomplished the feat in 1991. How did Kelly deliver such amazing results in his first two years as head coach?

He innovated. It's as simple as that. He saw problems others didn't and developed solutions others ignored.

Football coaches have recruited and developed players, and they have designed and run plays predicated on one core principle—if we are bigger, stronger, and faster, we'll win.

If you were in Kelly's situation, heading a program that had never even played for the national title, your success rate recruiting the biggest, strongest, and fastest players would be low. And as a result, your talent won't stack up, especially if your plays are designed to succeed on the basis of your players being big, strong, and fast. What's a coach of an up-and-coming program to do?

Redefine the problem. And by doing so redefine the solution—in terms of recruiting, player development, and play design and execution. That's exactly what Kelly did.

It turns out that big, strong, and fast are not the only attributes that can contribute to success in football, something that should have been obvious if coaches considered factors that lead to success in other sports. Another attribute is endurance. In basketball, soccer (football outside the US), and swimming, teams that have better endurance outperform their opponents as the event wears on. John Wooden (famous University of California, Los Angeles [UCLA] basketball coach) ran practices so fast they were more aerobic than actual games, so players always had a little more energy at the end of games than their opponents. By selecting and developing talent for endurance, then designing game execution strategies that position endurance as the key determinant of who wins, Kelly saw an opportunity to optimize in ways that other, more well-known colleges were not.

That's exactly what he's done. He recruits players less for their size and strength and more for their speed and endurance. His practices are run at a pace that makes game action appear slower, builds cardiovascular capacity, and is more likely to take weight off than put it on players' bodies. This approach translates directly into game strategy. Other teams typically take 34 seconds between the end of one offensive play and the start of the next; Oregon cuts that down to 23 seconds, leaving less time for opponents to catch their breath. The result? Oregon outscored opponents by a massive 115 points in the fourth quarter in 2010.

The point isn't that Chip Kelly innovated or that he is a football genius (even if he is). The thinking process that led to the innovation is the point. By redefining (abstracting) the problem, he was able to look outside the known best practices of his own sport, identify patterns of success not practiced in his sport, and create a version of that pattern of success in football.

In this issue of the *Technology Forecast*, we ask and answer the question, "is innovation the result of inscrutable, opaque genius, or can innovation be treated as an end-to-end process subject to performance optimization by adopting proven methods?"

We find that the time is now ripe for organizations to develop, manage, and continually improve an end-to-end process, supported by technology, in which innovations are more likely to be discovered, better assessed, and better converted into profits in what can become an idea-to-cash process. The key area for technology support is the systematization of problem solving, which is at the heart of how innovation happens and progresses.

The first article, "Can innovation be disciplined without killing it?," on page 06 examines the importance of problem solving in the end-to-end innovation process. The article highlights approaches that systematize problem solving so that more participants can contribute to problem solving, rather than just those in research and development (R&D) or product development functions. The article also lays out the key stages in the end-to-end process as ideas move from discovery to incubation to acceleration to scaling.

"Powering the innovation life cycle" on page 26 examines the software available to organize and discipline the innovation process. Idea management systems digitize the notion of an idea and organize innovation activities around the movement from ideas to cash. Solution identification approaches such as TRIZ provide methods to systematize problem solving and allow software support by treating innovation as another case of knowledge engineering, access, and distribution. Both approaches increase participation and transparency in the innovation processes.

"The strategic CIO's new role in innovation" on page 44 offers insight into how CIOs can use the IT infrastructure to support more disciplined idea-to-cash processes. Implementing and supporting end-to-end processes has long been part of the CIO's charter. To drive innovation, CIOs can contribute in two distinct areas. First, they can help drive the creation of the end-to-end innovation process. Second, they can put together and implement the technology on which the enterprise executes much of the innovation process.

These articles are supported by in-depth interviews with executives and thought leaders at companies on the leading edge of innovation management:

- Jon Bidwell and Patrick Sullivan of Chubb share their journey of innovation from ideas to marketable products and how information technology is enabling the process.

- Bill Hessler describes multiple cases of innovative problem solving using structured methods from his experiences at multiple engineering corporations.

- Matthew Greeley of Brightidea details how idea management systems and their openness and social software features create opportunities for IT to support innovation processes.

- James Todhunter of Invention Machine shares how systematic methods for problem solving and knowledge management can help enterprises sustain innovation.

- Paul McCusker of AES describes an example of innovation at AES and how that is seeding a platform for innovation across all AES facilities.

Please visit pwc.com/techforecast to find these articles and other issues of the *Technology Forecast* online. If you would like to receive future issues of this quarterly publication as a PDF attachment, you can sign up at pwc.com/techforecast/subscribe.

As always, we welcome your feedback and your ideas for future research and analysis topics to cover.

Tom DeGarmo, Principal
Technology Leader

Can innovation be disciplined without killing it?

Yes, by implementing innovation as an end-to-end idea-to-cash process and systematizing support for problem solving.

By Vinod Baya, Bo Parker, and Christopher Wasden

Edison's light bulb, Google Search, and the Apple iPod—many people would describe these hallmark inventions as examples of rare talent in action or the products of uniquely innovative companies. But to attribute them to "magical genius" not available to others lets everyone else off the hook with an easy excuse not to be innovative: "How could we possibly expect this type of rare talent or unique capability in our company?"

Is rare insight only the domain of the extremely brilliant? Is radical innovation conceived in a single, stunning act of invention and delivered as an entirely new offering? No. Innovation is a process. It is a process that taps into genius, but it need not be the accidental province of the madly brilliant, as these hallmark inventions illustrate. Even some of the most celebrated inventions don't quite fit the eureka moment stereotype.

Specifically, a disciplined problem-solving process in materials science led to the light bulb. Applying a ranking principle from one domain to another led to more satisfactory Web search results. Several incremental improvements to existing technologies and the vision to combine them led to Apple iPod and to iTunes, which together became the radical commercial innovation.

The common element in these examples: the enterprise could not move from idea to cash or business value because of some problem the inventors encountered. Solving the problem moved the process forward. And solving problems typically involves a disciplined approach, pattern matching, or a combination of these.

This issue of the *Technology Forecast* explores how organizations can develop, manage, and continually improve an end-to-end process, supported by technology, in which innovations are more likely to be discovered, better assessed, and better converted into profits—what PwC calls the idea-to-cash process.

This article examines the importance of a problem-solving approach in the end-to-end innovation process. The second article examines the software available to organize, manage, and systematize the problem-solving approach. And the third article offers insight into how CIOs can use the IT infrastructure to support more disciplined idea-to-cash processes.

> *"While innovation can be groundbreaking, it is more often the incremental improvements of existing technologies and methods—the sum of many small but constant changes that over time can transform the way a company or an industry does business."*
> —Jon Bidwell, Chubb

Innovation is not just an R&D issue. Innovation should be in everyone's DNA in the enterprise.

Hallmark examples shatter the innovation myth

There's no getting around it. Innovation is hard. It is one of the rare business activities that does not benefit from economies of scale. That is, large businesses are no better at it than small ones—and, in fact, are often worse. But the notion that brilliant individuals, using mysterious methods, create all the radical innovations is a myth. Implicit in the myth is the idea that innovation is beyond the reach of process improvement and discipline, and is impervious to management influence (other than management throwing more money at research and development [R&D]). But consider three hallmark examples:

- **Edison's light bulb—**Thomas Edison didn't arrive at the solution of tungsten filaments in a vacuum through once-in-a-lifetime insight. The basics of making a light bulb were known: pass electricity through a filament in a vacuum. The problem was the filaments he had tried did not last long. Edison's genius was dedicating scores of engineers to systematically testing thousands of materials as filaments. Eventually, they discovered tungsten lasted longest. Edison brought the idea to cash through a disciplined process to solving a problem.

- **Google's Web search algorithm—** Larry Page, co-founder of Google, was using the Alta Vista search engine to find e-commerce Web sites and encountered the problem of search results being plentiful but of limited value because they were not ranked by relevance. He connected two patterns: the importance of the web of links among Internet sites, and the way academics use journal citation counts to measure the importance of articles. Then, using the number of links among pages to determine which are seen first, he transformed Internet search. Page did it intuitively, but connecting two patterns from dissimilar domains can be used as a formal process to accelerate invention.

- **Apple iPod—**Apple released the iPod in 2000 to middling success, despite its creative combination of many smaller inventions resulting in an elegant portable music player. The problem: the digital music ecosystem was in chaos. Songs illegally ripped and shared on the Internet often were mixed with malware, there was no single place to buy tracks legally, and moving music between multiple sources and the iPod presented complex challenges. Apple soon made one additional, incremental invention to unlock the vast commercial success latent in MP3 players: iTunes as a safe, legal, and user-friendly way to get music to the device. Neither iPod nor iTunes by itself was radical innovation, but together they changed the game.

There are lessons here that all leadership teams need to take to heart.

"While innovation can be groundbreaking, it is more often the incremental improvements of existing technologies and methods—the sum of many small but constant changes that over time can transform the way a company or an industry does business," says Jon Bidwell, chief innovation officer of Chubb, for whom the end-to-end innovation process goes from idea to marketable products.

Innovation is high on the agendas of CEOs in virtually any industry. In the past, they might have focused on growing market share to drive growth. Now, they increasingly are focusing on innovation in new products and services. (See Figure 1.)

And they're confident their innovations will succeed: 78 percent expect their development efforts to generate "significant" new revenue opportunities over the next three years. It won't be easy. But they are making changes at all levels of their organizations to make sure they can take advantage of incremental innovations, as well as breakthroughs.
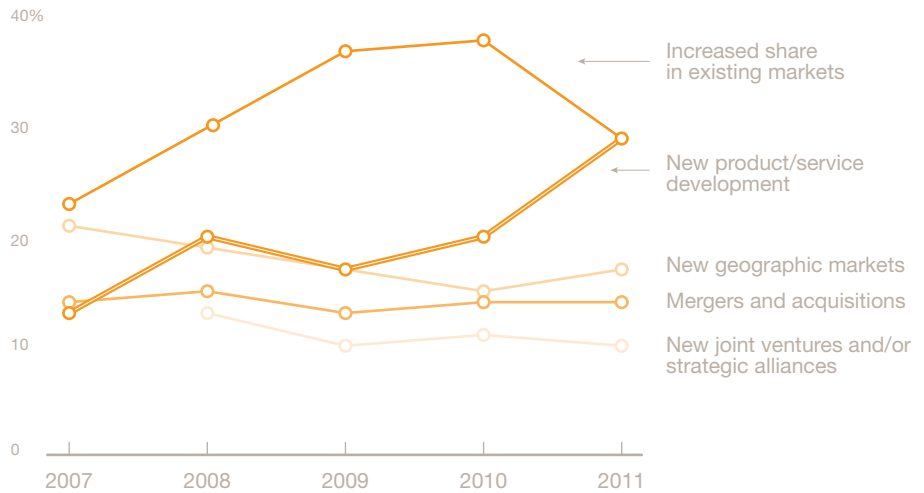
As Bidwell understands, it is time to discard the stereotypes of innovation, radical or otherwise, and treat it for what it is: an enterprise business process that can and should be better understood, redesigned, improved, and measured to improve performance. The rest of this article examines how.

Problem solving: Core to how innovation happens

A substantial body of research explores how intuitive innovators think and how their thinking patterns can be incorporated in the problem-solving steps that lead to innovation.[1,2] The literature usually refers to this approach as "structured problem solving." Two broad themes emerge:

1   Robert W. Weisberg, *Creativity: Understanding Innovation in Problem Solving, Science, Invention, and the Arts* (John Wiley & Sons, 2006).
2   Kathleen L. Mosier and Ute M. Fischer, eds., *Informed by Knowledge: Expert Performance in Complex Situations*, (Psychology Press, 2010).

What do you see as the main opportunity to grow your business in the next 12 months?

- Increased share in existing markets
- New product/service development
- New geographic markets
- Mergers and acquisitions
- New joint ventures and/or strategic alliances

Source: PwC 14th Annual Global CEO Survey

- Problem solving is core to innovation. Problems are what inspire innovators to look for answers. Problems often surface as tensions—loss of market share, decline in profitability, dissatisfied customers, and others. Natural innovators are good at defining the problems; they often see problems that others do not. "[Apple CEO Steve Jobs] will reject something that no one will see as a problem," former Apple CEO John Sculley has said.[3] Jobs has a knack for seeing problems—in a user interface or business model, for example—that the rest of the industry does not see.

- Almost all innovation involves the application of a known solution to a problem or part of a problem from one domain to a new problem in a different domain. Bill Hessler, an innovation expert, describes how nozzles designed for decorating cakes were used to solve a problem in designing gas turbine nozzles. (See the interview with Bill Hessler on page 22.) There are many other examples. Open collaboration, as a source of ideas that address design problems, succeeds because

it exposes the design challenge to a large number of people from different knowledge domains. This increases the likelihood that someone will intuit what the problem has in common with a problem—and a solution—outside the domain.

The combination of these two themes reveals how enterprises can recast invention[4] challenges into problem-solving tasks. Thinking about the invention challenge as problem solving—and using patterns and principles that already exist—greatly simplifies the invention task and transforms it into a process of knowledge search and pattern recognition. In the transformed invention task, process orientation and information technology will play a bigger role.

This problem-solving approach typically involves four steps, listed here and illustrated in Figure 2:
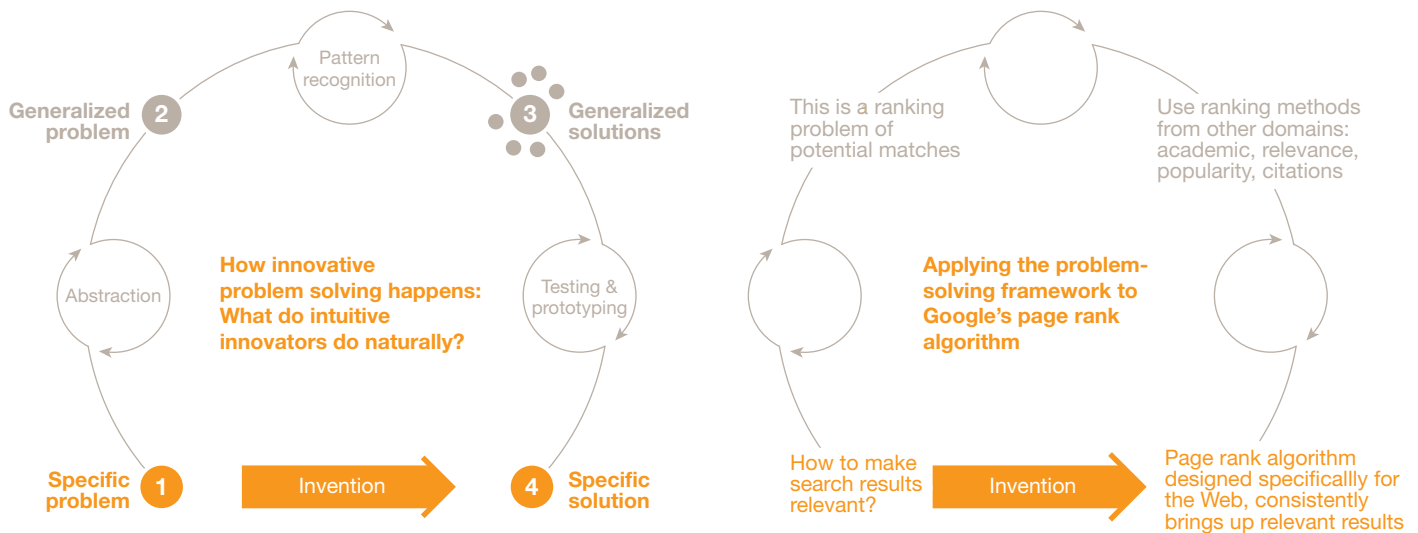
4   In PwC's terminology, innovation is a process from idea to cash, and inventions are the solutions that address problems at any stage in this process and therefore allow it to move forward.

3   John Sculley on Steve Jobs, interview transcript, http://www.cultofmac.com/john-sculley-on-steve-jobs-the-full-interview-transcript/63295.

Figure 2. A structured approach to how intuitive innovators solve problems and invent, and how that applies to Google's page rank algorithm.

1. Understand and specify the precise functional problem that needs to be solved—anything from a deep materials-science issue to a business model challenge. For example, despite the existence of many search engines, Page understood and focused specifically on the problem of relevance in search results.

2. Abstract the specific problem to a general principle so it can be mapped to a generic version of the problem. Rather than seeing the problem of poor search results as unique to the Web, Page saw it as a general ranking problem, which he then mapped to other domains.

3. Identify generic solutions to the generic problem to generate candidate solutions or approaches to the specific problem. This activity often means a creative mix and match of partial solutions to parts of the problem. The domain of academic literature and how it ranks the popularity of research led to the insight that Web links could serve a similar purpose.

4. Translate the generic solutions into specific solutions to the specific problem and thereby invent a new approach. In Google's case, this was the page rank algorithm.

Without a system or discipline, such problem solving is experienced as serendipitous or ad hoc. If an organization can discipline serendipity to make it happen more often, with more people, to yield more productive outcomes, then the organization would have higher innovation performance.

Enterprises often hire a consulting organization to tap disciplined processes and problem-solving methodologies. Some consulting organizations, such as IDEO and Jump Associates, accept the challenge of delivering the innovation for enterprises largely on an outsourcing basis. They combine techniques such as brainstorming, design thinking, and prototyping to bring discipline in their processes. Other consulting organizations, such as PwC, Doblin (a member of Monitor Group), and others, deliver services designed to

change internal processes so that future innovations can be generated by the enterprise itself.

TRIZ[5] is another example of a methodology that uses the principle shown in Figure 2 to systematize innovation. "What the intuitive innovator does subconsciously, TRIZ brings to the conscious level," says Peter Hanik, president of Pretium Innovation.

Hanik offers an example of how powerful this principle's search and application process can be. Ice storms have been capsizing fishing boats for centuries, despite many efforts to design boats less susceptible to flipping over after heavy ice collects on the decks. Not until a principle of energy transfer was applied to the problem did it occur to anyone that the temperature of the sea was high enough to melt the ice. It is now standard practice to pump seawater onto the decks of fishing boats to avoid capsizing in icy conditions. For a brief look at TRIZ, see the conversation with Peter Hanik in the sidebar on page 11.

5   According to Wikipedia, TRIZ is "a problem-solving, analysis and forecasting tool derived from the study of patterns of invention in the global patent literature." It is often referred to as the Theory of Inventive Problem Solving. http://en.wikipedia.org/wiki/TRIZ

A conversation about TRIZ with Peter Hanik, president of Pretium Innovation

PwC: Peter, what is TRIZ and how did you get interested in it?

PH: I first became involved with TRIZ in 2004. TRIZ is a systematic way of inventive problem solving based on methods that Genrich Altshuller developed in the former Soviet Union in the late 1940s. The basis for TRIZ is the hypothesis that there are universal principles of invention that are the basis for creative innovations. Invention is a result of applying TRIZ principles to selected problems to spark potential solutions.

My colleagues and I looked at how natural or intuitive innovators do things, and the first thing they'll do is define the problem. If you don't define the problem correctly, you obviously won't get the right answer. Next the intuitive innovator will study the system that contains the problem to understand cause-and-effect and select areas of opportunity within the system. Then the intuitive innovator will subconsciously abstract a principle from a previous problem that they've solved or read about, and apply it to the opportunity in the system they're working on. If that triggers an idea, then it is tested as a hypothesis. And if that works, it becomes a solution, or really, an invention.

The part where TRIZ comes in is the abstraction of a principle from a previous problem. What the intuitive innovator does subconsciously, TRIZ brings to the conscious level.

PwC: What are the practical steps that TRIZ brings to consciousness?

PH: In TRIZ, you are essentially doing one of three things and all are in a sense problem solving. Either you make a useful activity better, counteract a harmful activity, or resolve a contradiction. Resolving contradictions is at the heart of TRIZ. Most problem solving is about making a compromise or tradeoff between contradicting activities. For example, if you make a mechanical part thicker you increase its strength but you also increase the weight. If we can find a way to get more strength without the extra weight penalty, we have resolved the contradiction between strength (useful) and weight (harmful).

TRIZ researchers looked across an enormous number of past inventions—in particular those described in patents—and established a core set of principles that capture the essence of most all problems facing inventors or innovators, together with a set of principles that capture the essence of solutions to those problems.

Because TRIZ abstracts problem solutions to a set of common principles, the solutions can surface from any domain. Serendipity and creativity come in through a systematic process of mapping abstract principles from TRIZ to the resources available in the system at hand.

PwC: Can software support the deployment and use of TRIZ? What can a CIO do?

PH: The real power of TRIZ is in its inventive principles. Originally there were 40 principles, and many people have worked to refine and structure these TRIZ principles. Today, TRIZ inventive principles can be applied to any area of innovation—product, services, process, or business model.

From a CIO standpoint, the TRIZ inventive principles embedded in creative problem solutions are valuable information resources that can be captured and made available throughout the organization. For example, if I've solved a manufacturing problem or developed a new product, and I have identified the principles through TRIZ that are embedded in that innovation, I can capture those principles as keywords and make them searchable in a knowledge management system. This will make it possible to reuse or combine this solution in a different problem that needs to use the same principles. The organization is thus cataloging solutions and ideas for future use in a searchable and usable way.

In addition, the most valuable innovations are often business model innovations. Business models are driven by information systems, so the CIO has a key role to play in applying TRIZ in this particular kind of innovation.

PwC: Does TRIZ apply to techniques outside of engineering and manufacturing?

PH: A lot of people are working to use TRIZ beyond just the traditional manufacturing technology applications. To give you an example, years ago our chemical company sales force consisted of regionally distributed salesmen who sold all our polymer products in their region. We had a wide variety of products, and salesmen were not being effective across our entire product portfolio.

We applied the TRIZ principle "specialization" to our sales organization. We then reorganized the sales force so that sales reps sold only certain logically related segments of our products; that is, each sales representative's work was now "specialized." Some salesmen sold only to customers who were making films, say for garbage bags or related products. That was different from salesmen selling our products to customers that made molded parts. By specializing the sales force, and therefore the salesmen, it was easier for them to develop market and technical expertise, and sales performance improved.

The TRIZ principles can be effectively used to address these kinds of problems. I've done a good bit of work applying TRIZ principles to business processes, so I think the answer is, yes, TRIZ can be used in domains other than manufacturing, and more and more people are doing it.

PwC: Can TRIZ be compared to some other management trend from the past?

PH: Six Sigma is a comparable trend that can yield insight into how TRIZ can be applied in an organization. I've used elements of what companies have done with Six Sigma as a template. In Six Sigma, we teach people at the Green Belt, Black Belt, and Master Black Belt levels. We want everyone in the organization to have this Green Belt level of understanding, few to have Black Belt, and very few to have Master Black Belt.

A similar concept can apply to structured problem solving using TRIZ. If companies want to be more innovative as an enterprise, they need to make a similar scale of investment as they did in Six Sigma for quality.

Hessler, who has used TRIZ, says, "It frames all innovation as a search for existing solutions in different industries or contexts. In other words, your problem has already been solved and you just don't know it."

If this approach to problem solving, invention, and innovation is so powerful, so well specified, and so developed, where has it been all this time? One challenge is that most enterprises view innovative problem solving as a siloed activity, limited to the R&D and product development departments. A recent survey by Harvard Business Review Analytic Services found less than a quarter of senior management has high satisfaction with R&D outcomes and processes. (See Figure 3.) Clearly, if enterprises start to look at innovation as an end-to-end process, they could improve their innovation performance. This means marketing, product management, sales, customer support, strategy, IT, and even human resources need to incorporate creative problem solving in their daily jobs—supported by a disciplined and technologically advanced infrastructure.

Innovation is an end-to-end process

Innovation is value-creating novelty. It must be new, but it must also create value for the business. "The key is to leverage our capability at all levels within the organization and to increase the speed and scope of idea generation and transformation into marketable products that result in new business value," Bidwell says. Unless an innovative idea for a product, service, or business model is carried through to the customer, it will fail to generate cash or other value for the enterprise. It is therefore a process, rather than an activity.

The rise of open collaboration at companies such as Procter & Gamble, Cisco, and General Electric Company[6] has begun to create awareness of innovation as a process that starts with ideas. Many companies are making good use of their customers, suppliers, and Web-based "suggestion boxes" to broaden the source of ideas for enhancements to existing products or entirely new products.

About 40 percent of global CEOs expect the majority of innovation in the future to be co-developed with partners outside the organization, according to PwC's 14th Annual Global CEO Survey. (See Figure 4.)

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6   P&G operates an open innovation forum at Connect & Develop (www. pgconnectdevelop.com); Cisco's open innovation initiative is called I-Prize (www.cisco.com/web/solutions/iprize); GE's open innovation initiative is ecomagination Challenge (www.ecomagination.com/ challenge).

Figure 3. Senior management's satisfaction with R&D outcomes and processes

	Low	Medium	High[1]
Internal collaboration	23	52	23
External collaboration	19	59	21
New product development (NPD) process	20	56	23
Outcomes of NPD investment and programs	19	56	24
NPD rate	32	50	17

0%   20%   40%   60%   80%   100%
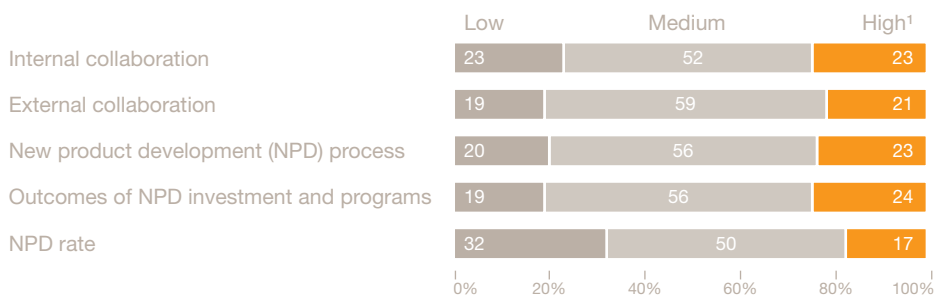
[1] On a scale of 1 to 10: Low = 1 to 4, medium = 5 to 7, high = 8 to 10
Source: Harvard Business Review Analytic Services

In the journey of innovation, ideas—whether incremental or radical—are just the beginning and they need to move from discovery to impact on the business. Figure 5 shows this idea-to-cash life cycle as PwC constructs it. Managing a set of ideas beyond discovery through logical stage gates of incubation, acceleration, and scaling are the execution steps upon which most companies stumble.

The following summarizes the key activities in each phase:

- **Discovery phase**—The primary purpose is the exploration, identification, ideation, screening, and selection of ideas to determine feasibility and create a proof of concept. A key problem is to generate a constant flow of ideas. Driven by open innovation paradigms, the sources of ideas increasingly include customers, suppliers, partners, and other external organizations or individuals. This open model has become a best practice among innovation leaders.

- **Incubation phase**—This phase eliminates technical risk by creating working prototypes and pilots and explores additional ideas regarding the value proposition among buyers, users, and beneficiaries. Companies that do not address problems in this phase are unlikely to advance innovations beyond discovery. The prototypes and pilots provide the basis for conducting additional product and market research to develop a robust business plan for the innovations needed to advance to the acceleration phase.

- **Acceleration phase**—This phase eliminates the initial commercial risk by demonstrating that there is a meaningful market among various segments. As such, this phase requires a large commitment of resources and time. In this phase, problems related to commercialization of a product, process, or service are solved. The

Figure 4. CEOs expect the majority of innovations in the future to be co-developed with partners outside of the organization.

To what extent do you agree or disagree with the following statements about your expectations regarding your company's innovation over the next three years?

■ Agree strongly ■ Agree ■ Disagree ■ Disagree strongly

1 An important part of our innovation strategy is to develop products or services that are environmentally friendly
23% 41% 12% 5%

2 We expect the majority of our innovation to be co-developed with partners outside of our organization
9% 30% 24% 13%

3 We use M&A as a significant source of innovation
7% 26% 26% 18%

4 We expect the majority of our innovations to be developed in markets other than the country in which I am based
10% 19% 27% 24%

5 We expect government assistance to boost our innovation output
7% 18% 27% 29%

Source: PwC 14th Annual Global CEO Survey

team applies more formal structures and practices to ensure greater discipline, yet remains flexible enough to exercise agility in adapting the product, process, or service to the market's needs.

- **Scale phase**—In this phase, the primary problem to address or the risk to manage is the size of the market opportunity. The result of the acceleration phase is now fully established as a core product or service offering.

Challenges and risks facing an innovation don't stop if their nature changes during different phases of the life cycle. All great ideas sourced in the discovery phase will

encounter numerous execution challenges in all phases, or problems that need solutions, for which structured problem solving can deliver dramatically better results.

It is also important to note that only a fraction of ideas move through the full life cycle—not all ideas can overcome all challenges and risks encountered during their development. As few as one in a hundred seemingly great ideas may eventually succeed and become a commercial offering. Built into disciplined problem solving are mechanisms to drop ideas when core problems have been exhaustively examined for solutions, which should be done as early as possible in the life cycle. This approach is often referred
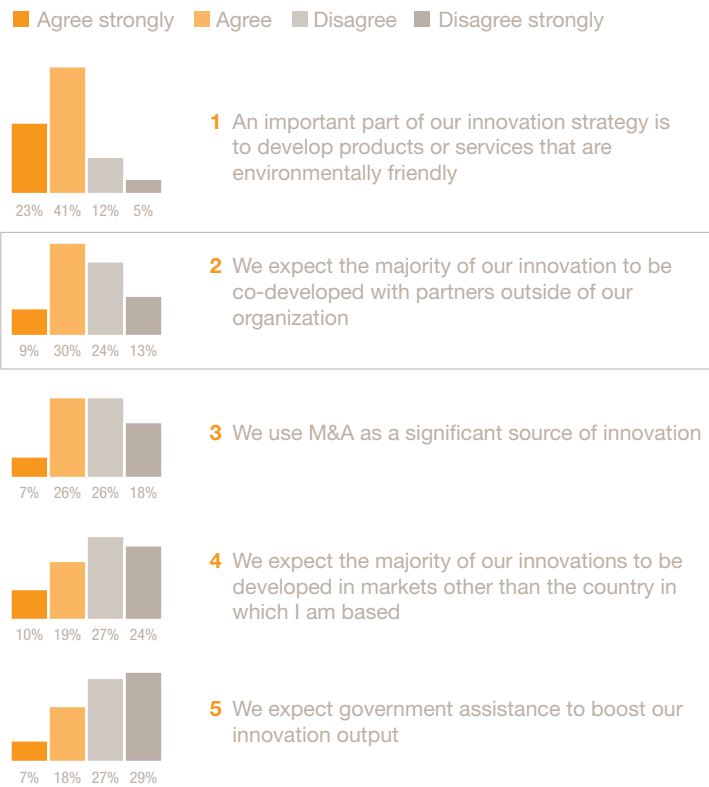
Enterprises should treat innovation as an end-to-end process from idea to cash, and each problem faced in this process is an opportunity to invent a solution that moves the process forward.

to as a fail fast strategy, so that only the most promising ideas move forward. Organizations also learn from failure. Fast, frequent, frugal failure decreases the learning cycle time and allows organizations to come up with better ideas faster in the future.

"If you want to come up with 10 or 20 ideas or directions for your company, you need a structured approach that thoroughly scans the range of possible solutions from many different domains," Hessler observes.

An end-to-end innovation process "is important, because ultimately innovation's success is not idea generation; it's a lot of pick-and-spade work," says Patrick Sullivan, chief architect of Chubb. "I liken it to building a road. It is one thing to draw a line and say that's where we want the road to be. It's another thing to get all the equipment and

people, blast the passes through the mountains, level all the stuff out, grade it, surface it, and everything else. Organizations fall down in this, because the execution is really hard."

Enterprises should treat innovation as an end-to-end process from idea to cash, and each problem faced in this process is an opportunity to invent a solution that moves the process forward. In many cases, the problem-invention challenge identifies and clarifies the real opportunities for sustainable competitive advantage.

Business process support for thinking is on the rise

If innovation has been so important, why hasn't it been addressed as an end-to-end process to be optimized before now?

The history of process improvements, particularly those associated with the use of IT to implement best practices and to establish managed, end-to-end processes, starts with activities focused on managing behavior to common standards. Behavior-dominated business processes are primarily activities that require limited thinking, problem solving, or creativity. Some examples include accounting for a purchase, keeping track of how employees spend their time, and noting the details of an item being put into inventory. These are detailed, data-capture-oriented activities.

Over time, the focus of enterprise performance improvements grew to include activities that require more thinking, more knowledge, and direct support to enable staff to reach more informed conclusions. One example is the establishment of enterprise-wide standards and processes for measuring employee performance, providing coaching, and deciding compensation and promotions. Many IT vendors now offer applications that introduce end-to-end management of the performance appraisal process while those who know and work with the staff retain the role of evaluation and assessment.

Figure 5. The end-to-end idea-to-cash process is the life cycle of innovation that moves through four key stages. The height of the bar suggests the amount of resources an enterprise might need to commit in any stage.
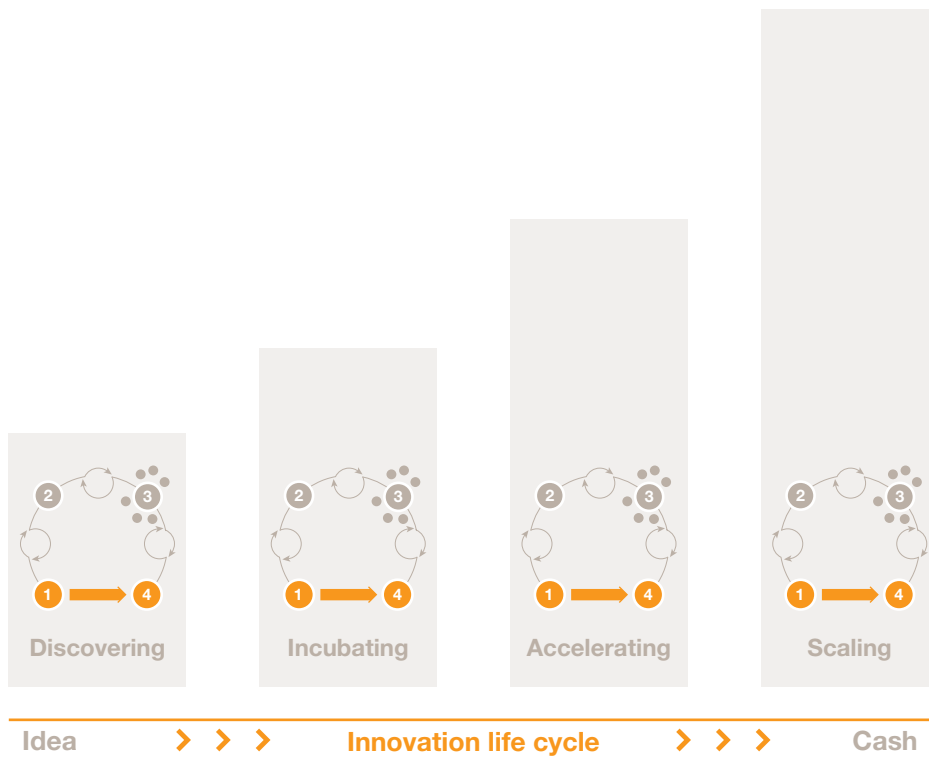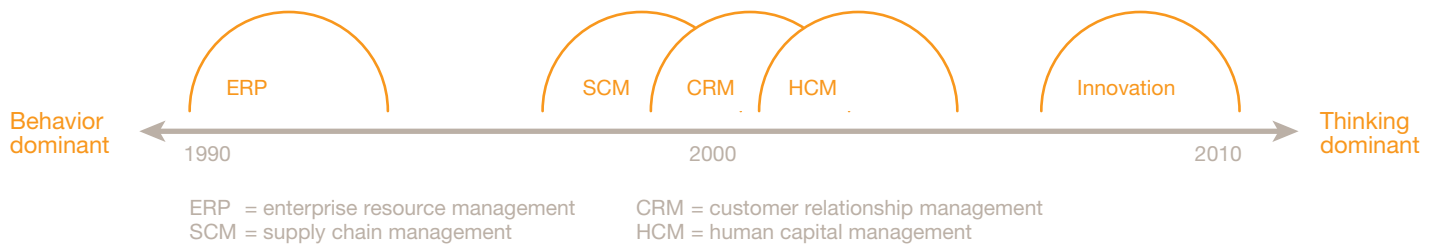

Discovering   Incubating   Accelerating   Scaling

Idea 〉 〉 〉   **Innovation life cycle**   〉 〉 〉   Cash

Figure 6. Evolution of enterprise performance improvement

Behavior dominant

Thinking dominant

1990   2000   2010

ERP   SCM   CRM   HCM   Innovation

ERP = enterprise resource management
SCM = supply chain management

CRM = customer relationship management
HCM = human capital management

The trend is clear. As Figure 6 shows, the target of enterprise performance improvements to end-to-end processes is steadily moving in the direction of more thinking. Innovation has been a challenge for the enterprise, in part, because it requires far more thinking, analyzing, knowledge leverage, and creativity, with much less scripted behavior. Now, enterprise applications are beginning to deliver more subtle support for semantically rich business activities such as idea management, problem solving, and invention—all keys to successful innovation. "Innovation is a social activity, and until software became social, it was impossible to really try and automate the innovation process," says Matthew Greeley, CEO of Brightidea.

In part because of its high requirement for analysis, creativity, and social interaction, innovation has not been seen as a broadly connected collection of enterprise activities subject to process discipline or re-invention. Just as beliefs about performance management evolved and are now included in human capital management (HCM) applications, innovation increasingly is understood as being more than creative insight occurring at unpredictable times from inspired individuals.

The changes companies need to make to their siloed approaches to innovation may be jarring to some. But enterprise-wide transformation always ruffles feathers and faces

initial resistance. That's why the best organizations plot a collaborative, strategic program of change to maximize their chances of success.

Because enterprise transformations have occurred in the past, pattern matching suggests ways to succeed in the innovation domain. For example, when organizations transform siloed, disconnected, suboptimal processes into seamless, responsive, and efficient end-to-end enterprise processes, they focus on four deliverables: common nomenclatures, digitization of interfaces, a technology-enabled new process, and continuous monitoring and improvement. The article, "The strategic CIO's new role in innovation," on page 44 explores these in more depth.

Barriers to innovation

What keeps good ideas from moving to cash and bad ideas from dying a quick death? It depends on how the enterprise executes on the idea.

Developing a good understanding of the end-to-end process shown in Figure 5 is a key first step. To jump from discovery to scaling without going through incubation and acceleration results in suboptimal outcomes. It is like trying to go from infancy to adulthood while bypassing childhood and adolescence. You're not ready for it. Managing ideas to cash is also fraught with other challenges. The biggest factors in poor innovation execution within the life cycle include the following:

- **Selecting the wrong ideas to develop**—Companies often have poor connections between idea sourcing and company strategy. They forgo ideas that should be developed, and they overinvest in ideas that are off strategy. An end-to-end process approach addresses this scenario by defining a "reverse funnel" that translates the business strategy into ideas through "innovation challenges." These requests direct creative thinking in useful ways at the beginning of the idea-to-cash process and guide those people making decisions about which ideas to develop further. A related issue is supporting for too long new ideas that are failures and not having the discipline to kill bad ideas.

- **Transferring ownership of the idea too soon**—The people (staff or collaborators) who originate an idea are usually the most passionate believers in it. But ideas don't represent fully detailed product or service descriptions. Even the best ideas go through a series of specification and design challenges from their earliest stages through prototyping and market entry. At some point the idea originators usually become less involved in its development—for example, if it requires deep engineering analysis. But the early days of specification are also open to challenges. Separating the idea from the idea generators too soon can lead to great ideas being killed by status quo inertia, a lack of creative energy and tension, and misunderstanding.

> *"Innovation is a social activity, and until software became social, it was impossible to really try and automate the innovation process."*
> —Matthew Greeley of Brightidea

- **Failing to solve design problems—** As ideas flow through the process, they encounter many issues. Edison's original light bulb was a good idea facing a fatal design problem. Invention is, in fact, solving the problems good ideas face by using and creating knowledge—in Edison's case, discovering that tungsten would burn in a vacuum for many hours. This is the crucial thinking part of the innovation process, and most companies do little to enhance it. The most innovative companies use advanced information technologies to augment problem solving by treating it as a knowledge engagement, interaction, and growth challenge.

- **Failing to design for scale**—Many great ideas are successful as one-offs, and companies can find a few customers willing to pay a premium for the new product or service. Truly transformative ideas often face additional design challenges to drive out cost to address the much bigger, price-sensitive part of the market. Progress is subject to knowledge engagement enhancements to the innovation process, described in more detail in the next section.

Any serious effort to transform enterprise innovation must address all of these challenges. The effort must introduce meaningful metrics and adopt a continuous improvement ethic. The good news is that idea management systems are now mature enterprise applications capable of addressing the key life-cycle challenges of idea selection, idea management and handoff, and innovation metrics. (See the article, "Powering the innovation life cycle," on page 26.)

Problem solving: A special form of knowledge management

Applications are becoming available that help manage the complexity and learning issues associated with structured problem solving. They do this by addressing the two biggest mental challenges facing anyone trying to adopt structured problem solving:

- Translating a specific problem into an abstracted, generic version that maps to a generic principle is difficult. It requires a creative step and the ability to recall the many principles that define the problem/ solution universe. The best software allows problem solvers to define their issue in relatively specific terminology, and it returns candidate solutions from multiple domains. This approach transforms the mental process into something closer to a pattern recognition task rather than a recall task. As all software designers know, and as psychological science informs us, humans are much better at recognizing patterns than at remembering a lot of specific detail.

- Having access to as large a body of relevant problem/solution knowledge as possible is a major challenge. Software that captures semantically meaningful functional descriptions of problems and solutions addresses this challenge. Invention Machine's Goldfire software does this by semantically analyzing inputs to the company's knowledge base—patents, proprietary functional specifications, and so on—and queries by users, using the problem/solution principles as metadata.

Applications that support structured problem solving can also be understood as digital interfaces in a business process that today is mostly analog or human based. As problems are encountered and solved, by your enterprise or others, the flow of knowledge is added to the palette of potential solutions available to the enterprise digitally. No people need to assess, classify, or otherwise intervene.

Conclusion

Today, structured innovation methods and the software that supports them typically remain isolated in R&D. Yet enterprises have awakened to the need to seek ideas not just from staff in product design and engineering but also those in customer-facing, manufacturing process, business strategy, and partner management functions. The challenge has been that staff outside R&D aren't engaged with problem solving and innovation frequently enough to become adept at the methods or software. And they typically don't have the time to work on these problems, which require close attention.

Innovation is not just an R&D issue. Innovation should be in everyone's DNA in the enterprise. "What you do is simply create the knowledge base. You have the tools in place so that this [innovation] simply becomes the set of ethics, practices, and beliefs that are fundamental to as many people in the organization as possible, and they simply think and act that way," suggests Bidwell.

The current generation of enterprise applications designed to enhance innovation through the support of structured problem solving is just beginning to capture the attention of business units outside R&D. (See Figure 7.) PwC believes these products are already being enhanced with thoughtful redesigns that bring most of their value to a broader range of enterprise problem solvers and idea generators in a more compelling, accessible interface.

Extending these methods and capabilities throughout the organization is imperative. Even after a brilliant idea is identified, it often faces many conceptual, engineering, market development, distribution, and customer acceptance challenges that demand creative problem solving. In short, the structured innovation approach can contribute beyond the discovery phase. Indeed, it is crucial that innovation also be applied to the incubation, acceleration, and scaling phases of new product development.

In other enterprise contexts, such as human capital management, thoughtful activities can be enhanced by the right software design and underlying technologies. As this happens, the highest performing, most innovative enterprises will be those that have brought their innovation and problem-solving worlds together as part of a full life-cycle, end-to-end, managed process.

Figure 7. Simplifying problem solving for infrequent users is the opportunity space for introducing IT into the end-to-end innovation process.
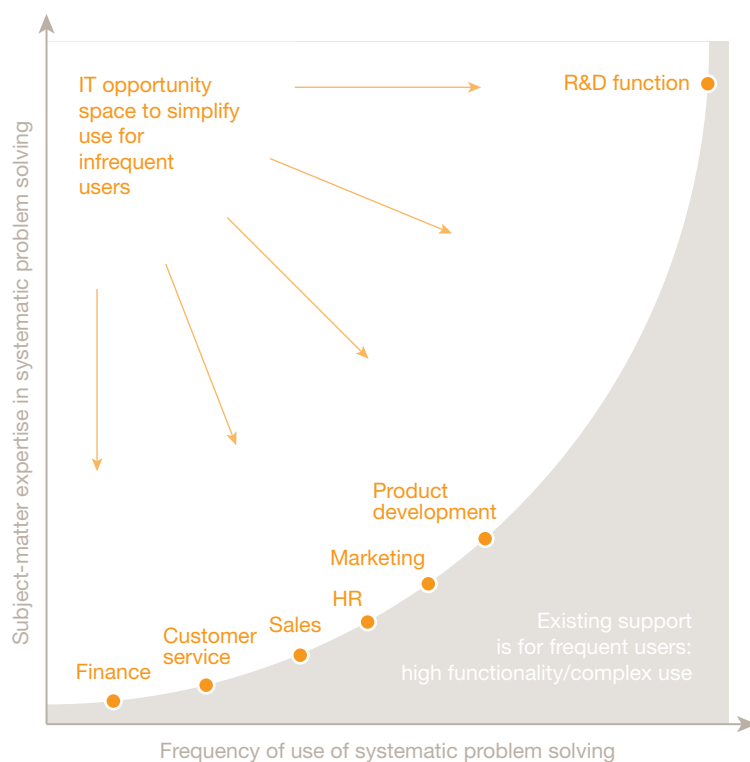
Seeding innovation at Chubb

Jon Bidwell and Patrick Sullivan of Chubb share their journey of innovation from ideas to marketable products and the role of IT.

Interview conducted by Vinod Baya and Bo Parker

PwC: What is your view of innovation and what role does information technology play in it?

JB: For most people, thoughts of innovation bring to mind major technological breakthroughs such as electricity, refrigeration, laser, telephone, and so on. While innovation can be groundbreaking, it is more often the incremental improvements of existing technologies and methods—the sum of many small but constant changes that over time can transform the way a company or an industry does business. Both are important to an enterprise.

Ongoing trends and business dynamics in our industry require the ability to very quickly sense market changes and where future demand may exist. In doing so, we want to leverage the knowledge and capability of our global employee base and to somehow, particularly in a virtual manner, pull those people together. Enterprises need to either have a pipeline of incremental innovations or start to nurture and experiment with the more disruptive innovations. The key is to leverage our capability at all levels within the organization and to increase the speed and scope of idea generation and transformation into marketable products that result in new business value.

For us, nearly every road of innovation leads back to information technology. Once upon a time, it might have been brochures or sales pitches or putting more guys on the road in cars. Today, whether it's salesforce.com solutions linking the sales force together, development tools, mobile tools, or whatever it may be, all of these things lead back to technology and our ability to manage its evolution.

PwC: We've read that you have implemented an idea management system and are using an open innovation approach. What impact has that had on innovation at Chubb?

JB: Yes, we have been using an idea management system for over two years, and more than 1,500 new ideas have been developed during that time. Several business cases have been funded and more are in development. The idea management system has allowed us to successfully shift the "center of gravity" of innovation to line employees and out to agents, thereby embedding innovation deep into our day-to-day operations.

Jon Bidwell and Patrick Sullivan

Jon Bidwell is the chief innovation officer for Chubb Group of Insurance Companies. He is currently responsible for managing Chubb's global innovation platform, internal venture fund for new ideas, as well as Chubb internal and external social media and collaboration tools.

Patrick Sullivan is the chief architect of Chubb in the CIO organization. He has extensive experience in the insurance and financial services industry at the senior management level, holding various positions from business analysis to enterprise architecture. Sullivan has particular expertise in the areas of IT strategy, governance, and business architecture.

In this interview, Jon Bidwell and Patrick Sullivan detail how transparency of ideas and creating new capability by combining existing modular and discrete functionality is allowing IT todrive innovation at Chubb.

As we sense changes in market needs, we need the capability to generate and screen ideas for new products, enhancements, and services quickly and efficiently. The idea management system helps with that. We then take the most promising ideas and find the financial and human resources needed to bring them to market.

PwC: Patrick, how has that affected the role of IT in innovation?

PS: The idea management system creates a great deal of transparency around innovation. Now we can see ideas as they're being formulated, so we get at least a quick look into what folks are thinking, where ideas are going, and where there's some commonality as well as themes and threads. It really helps us determine where we want to do research or where we want to look at things from an operational perspective—to think about how we would operationalize some of these ideas before they're well formed.

So as others are forming the ideas through the innovation capability that Jon has developed, we're able to see those ideas, think about them in advance of seeing the business case, and be better prepared to help.

PwC: As Jon said, many ideas depend on IT to bring them to business value. What are you doing to be more responsive to execute on the good ideas?

PS: From a technology perspective, many new ideas often need a new way of using existing capabilities or of exposing them either through different external channels or through newer processes that are internal. By conceptualizing IT capabilities as a set of services, we can put these capabilities onto the shelf, so to speak, and expose them for quick reuse, whether it's a reporting application for a BlackBerry or some form of a customer-facing application.

"The idea management systems are good because you can bring many viewpoints—often geographically dispersed and then across different competencies—together very quickly if you're artful about it."
—Jon Bidwell

But if our information and capabilities are locked in our monolithic legacy systems, then every time we implement a new idea we must either build something new, which will increase maintenance costs over time, or refactor a legacy application. If you're refactoring a legacy application at the point that you need it, you're going to be too late to the market.

We use service-oriented architecture [SOA] to build discrete units of business functionality that we can use in many ways. So when these new uses come up—combined with an early view of the idea pipeline—we're able to bring good ideas to value quickly.

PwC: Businesses increasingly operate in digital ecosystems. We find that there continues to be opportunities to change analog interactions to digital interactions to drive efficiency and flexibility. How much runway do you see to digitize interfaces and bring innovation to existing operations?

JB: I would say that we're just scratching the surface. For instance, in Chubb's claim service centers, gains can be achieved just by getting more paperless tools, so getting to electronic files, dual screens, and digitizing the interface with vendors, such as windshield, glass repair, and restoration companies. There is a lot of runway there.

Also, in some situations a simple change can get you a ton of mileage and assets you can leverage, because you can dramatically speed up transaction flow. For example, we have a defined process in a first-party claim settlement for personal insurers. We very recently put in the ability to generate an alert every time a critical threshold was hit, and that alert would be sent to the agent who handled that customer. From a technology standpoint, creating that ability was neither difficult nor expensive to do. We were responding to an innovative idea. We could do it because we had defined all of these process stages electronically, and we cut tens of thousands of status update calls out of the claim service centers in one shot.

PS: There's still a lot of runway for optimizing processes by using the technologies that we already have today and the communication channels that we've opened up with prospects, customers, or the producer workforce. When we look at things of the nature of the latest, greatest, and the new form factors and devices, we can make greater use of the intelligence that we already have and optimize.

PwC: How are you positioning IT to take advantage of this opportunity? Are you lowering the barrier to how quickly you can deliver new IT capabilities?

PS: For us, SOA is highly important and strategic. It's being able to black box and provide boundaries around specific capabilities that we're going to supply to our enterprise, especially in terms of our legacy assets and legacy modernizations. We focus on being able to design for obsolescence. That is, we want to define a discrete unit of functionality that we will build and be able to replace without needing to rip and replace an entire $100 million or $200 million policy administration system or whatever it cost us to build.

We look at components of functionality, such as our ability to generate documents, our ability to generate interfaces, or our ability to link to things like comparative raters or agency management systems. And then we provide those same types of business services, whether it's a rating, quoting, or booking premium. Whatever those major pieces of functionality are, we build and design our software for it.

Then we would look at things like cloud computing, which provides software as a service and helps build out our infrastructure completely. Cloud computing is also a function or component of a service-oriented architecture in that we can use different units of functionality to provide different aspects in a new workflow or to help us build new IT capabilities.

PwC: As you become more open to third parties and others in the digital ecosystem, what issues do you encounter and how do you take care of them?

PS: First, we have core competencies in our business that IT maintains as strategic advantages. We understand and protect these core competencies. As pieces of our infrastructure are used by third-party providers, whether it's cloud or outsourcers or just folks who can build and integrate with our capabilities because maybe they have an edge on the information asset that we don't have, it raises the bar on us to research and understand who we're really doing business with and how to manage from a security perspective. It also puts emphasis on maintaining the scalability and reliability of those services or applications. And, in some cases, it also increases the maintenance effort.

Those are things we address from the perspective of the architecture. It's the why we do it, not so much how we do it. If we're doing something to make a speed-of-efficiency play for a strategic advantage or to reduce operational costs, we look at architecture in terms of the big picture. We understand the business value, and then we make sure that there's a value statement after we look through all the capabilities. And, we make sure that we are providing a maintainable, secure environment, because our reputation and mission-critical operations are on the line.

You start to find where you have bottlenecks within the organization. You may aspire to do a lot more innovation, but it's a lot of pick-and-spade work to bring an idea to fruition. I liken it to building a road. It's one thing to draw a line and say that's where we want the road to be. It's another thing to get all the equipment and people, blast the passes through the mountains, level all the stuff out, grade it, surface it, and everything else. Organizations fall down in this, because the execution part of it is really hard. Going forward, we look at how we continue to lower the barrier to execution of the ideas so that new ideas can come to value quicker.

> *"The [idea management system] really helps us determine where we want to do research or where we want to look at things from an operational perspective—to think about how we would operationalize some of these ideas before they're well formed."*
> —Patrick Sullivan

PwC: One needs knowledge to work on ideas. Ideas themselves are knowledge. Have you done anything from a knowledge standpoint to support innovation?

JB: We are increasingly going back to what we call the warehouse, or the store of ideas, and looking under particular topics and pulling things out. So with this notion of trying to create a better ecosystem, we're learning now how innovation works. Thankfully, we made a decision to be very rigorous in how we tagged and built our taxonomy for ideas that went in, so we actually can find things very easily by very specific topics.

PwC: We are trying to understand what role tension plays in driving innovation—especially the tension created by ongoing business. Have you seen any correlations in this regard?

JB: There's plenty of tension in any kind of innovation, and the more disruptive the innovation the more tension there is. I'm a big believer that tension is good for innovation. The idea management systems are good because you can bring many viewpoints—often geographically dispersed and then across different competencies—together very quickly if you're artful about it. That is something that we're constantly learning about. For instance, you can try to build up some of these rudimentary scoring models to come up with ways to rank ideas. However, it really is about the tension and the tradeoffs in return, complexity, cost, revenue, and different components that all have different constituencies within the firm.

PwC: As you see your role and the impact of your role on your broader organization, will the legacy be that innovation is sustained across points in time?

> *"The aspiration is [for innovation] to become invisible. You have the tools in place so that innovation simply becomes the set of ethics, practices, and beliefs that are fundamental to as many people in the organization as possible."*
> —Jon Bidwell

JB: The legacy or the aspiration is to become invisible. I mean, what you do is simply create the knowledge base. You have the tools in place so that this simply becomes the set of ethics, practices, and beliefs that are fundamental to as many people in the organization as possible, and they simply think and act that way. It's the reflex. When somebody drops a dollar out of their pocket and you're walking behind them, you pick it up, you tap them on the shoulder, and you hand it back to them.

Innovation should be like that. If you're a salesperson, you should always be thinking, what's the pain point here, am I satisfying it, and how could it be done differently? If you're the underwriter, you're thinking, how could I improve the product? It's why we spend a lot of time with the learning and development groups and our internal business schools and the like. We have them do live innovation events and we teach them the process so that we inculcate that in as many people as possible.

That should just be the way—if you're the right person for this organization, that's how you should be thinking every day. You should never be satisfied with status quo, staying in place, or just polishing the business that you have today, because someone will come and take it away from you.

Systematizing innovation

Bill Hessler of Equipois describes multiple cases of innovative problem solving using structured methods.

Interview conducted by Vinod Baya and Bo Parker

PwC: Bill, at several different companies, you've had a series of innovation experiences that share a common theme—using structured innovation methods to identify unusual solutions to vexing design problems. Can you describe a couple of them?

BH: I'm a project engineer. I have worked in industry for 20 years, and my first job was with Ingersoll Rand. I was a trainer, with engineers and designers. We made primarily impact wrenches and screwdrivers for Ingersoll Rand Power Tools. One day marketing came to engineering and said, "I want to see the next-generation power tool." We went off with probably 20 or so engineers to figure it out. Some guys had more than 30 years of experience with only power tools, so they were born and raised in power tools, so to speak, right out of engineering school.

One of the issues being addressed at Ingersoll Rand was customers thinking that a car wheel's lug nut was tight when it really wasn't. The wheel then either loosened or fell off, and that was a very bad thing. Our marketing department had that problem in the back of their minds, but in addition they wanted to come up with the next-generation power tool. The engineers that had 20 or 30 years of experience thought they knew exactly what this power tool would look like. It was going to be quick, fast, and lightweight, made out of plastics and composites. It was going to be sexy looking and sleek. It was going to look like a stun gun from *Star Trek* or *Star Wars*.

We were just starting to use structured innovation methods, so the innovation instructor said, "Let's build a function model for a power tool," which is a key starting point in the structured approach. We built this function model of a power tool with all the components in a power tool, and we generically defined how each component is related to other components. We noticed that the function model was consistently pointing to two key areas: the air motor and the tightening mechanism.

Bill Hessler

Bill Hessler is a senior product development engineer who has used innovation techniques throughout his career, spanning four different industrial and medical manufacturing design companies. He has four US patents filed and more than 12 pending approval. His main innovation tools are the basic TRIZ principles and Invention Machine Goldfire software.

In this interview, Bill Hessler shares his experience of using a structured innovation method supported by semantic knowledge search capabilities to solve problems in innovation processes.

One principle we had learned in the structured innovation approach is called elimination; another is combination. So we looked at the air motor and the mechanism and said, "What if we combine the two or eliminate the two?" Those are the two big problem areas. As a thought experiment, we asked, "What if we got rid of the air motor and the mechanism?" The experienced guys said, "There's absolutely, positively no way you can build a power tool without an air motor and a mechanism. We've been making air motors and mechanisms for 60 years here. There's no way you can do it." But the thought experiment forced us to realize that if lug nuts are vibrating loose on the car tire, then we should use the same effect to vibrate the lug nuts on— rather than using the traditional air motor and mechanism. Everybody's jaw hit the floor when we realized it was possible to do this.

Subsequently, the engineers came up with a high-frequency vibration tool that was electrically powered. It had no air motor or traditional mechanism. Instead it had a small motor and it vibrated. It actually vibrated the lug nuts on. Within a year, they had a product designed and tested and worked out, together with a couple of patents.

PwC: Interesting. So you structured the innovation problem from a conceptual point of view by asking yourselves, "What would a tool look like without the complex machinery that was core to the product but also the source of the problems?" Is there a broader principle here?

BH: When I refer to structured innovation methods, I'm really talking about the TRIZ principles.[1] TRIZ is an approach to innovation that came out of Russia more than six decades ago. You can use the TRIZ principles to solve thorny design problems and be more innovative because it frames all innovation as a search for existing solutions in different industries or contexts. In other words, your problem has already been solved and you just don't know it. Many of these fall into the category TRIZ calls contradictions; that is, the inability to find a solution to a problem that doesn't also create costs or problems in another part of the system.

For example, to add strength to a component, you can always make it bigger and fatter and thicker, but in aeronautical applications, that isn't always an option. You want to make the component stronger but lighter. That's a contradiction. Well, contradictions are one of the 40 TRIZ principles of structured innovation methods. How do you make something stronger but lighter? TRIZ suggests changing the material. Or changing the structure of the material.

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[1]   http://en.wikipedia.org/wiki/TRIZ

Later in my career I took a position at an engineering company that is a supplier to electric utilities. When I first started there I was told, "Bill, you're going to be on this gas turbine fuel nozzle project. Take this fuel nozzle that already exists that's 25 inches long and shrink it down and fit it into the 15-inch fuel nozzle package for the smaller gas turbine."

I said, "A chimpanzee with a photocopier could do that. What problem do you want me to solve?" And they said, "Well, you know…," and I kept asking why. "Why do you want me to shrink this thing? We can go to CAD [computer-aided design] and shrink it immediately. What problem are you trying to solve?" They finally told me, "Well, these guys left the company and started their own company. They're making fuel nozzles, and we're losing market share."

"Why are they doing that?" I asked. They said, "They're making fuel nozzles with fewer parts." I asked again, "Well, why are they doing that?" "Because they know welds are bad." "Well, why are they doing that?" "Because every weld must be inspected." "Why are they doing that?" "Because if they miss a bad weld, and a part goes loose, it takes the gas turbine out."

Ah, so the real goal was to make parts better, cheaper, and faster, but we didn't want to change the way we were making stuff. Engineering just wanted to take this design they already had and shrink it 20 percent.

Next I said, "The real function of this part is to enable customers to change fuels on the fly. They want to run one fuel in it today and another in it the next day or the next week. So we need to have a function on our fuel nozzle that's easily tunable or changeable. And we want to make it with fewer parts, because that will mean fewer inspections of welds and lower costs. What approaches have you considered?"

> *"You want to get your employees to be more effective and to look at information that they might be overlooking. Intelligent software is the best, most efficient way to do it."*

The chief engineer kept saying, "We keep our eye very closely on the competitor." So I asked, "What about stuff at companies that aren't competitors, like showerhead companies?" The chief engineer said, "Oh, well, showerheads. That's water in a showerhead." I replied, "Yeah, but when I'm standing in my shower and I turn on the water and I want the pulse or stream or raindrop experience, I flip a switch." That's exactly what we were trying to do in the gas turbine arena. Customers might want to run certain heavyweight fuels through it at first, because it's cheaper, and next week they might have methane coming out of the ground, and they pump methane to it.

Another parallel we identified was the similarity between fuel nozzles and cake-decorating nozzles. As strange as that sounds, I brought that to a chief engineer, and I said, "Look at this cake-decorating nozzle and the way that it looks exactly like the fuel nozzle on an aircraft that fluctuates and can do the afterburner kind of thing you see on a flight deck." He said, "Hey, that's a pretty cool idea." And I said, "Yeah, and it's simple." It's in a cake-decorating piece of equipment. It's a $1 part. We immediately said, "That's a good idea."

The outcome? What was a $10,000 fuel nozzle became a $5,000 nozzle. And everybody said, "Holy cow. That's a pretty cool approach to innovation." And I said, "These are just simple TRIZ principles at work."

At some of the companies where I've worked, there was no true process for innovation. Incremental solutions to incremental problems get you only so far. More far-reaching solutions come through happenstance, such as times I've been in a toy store and I see a toy that reminds me of a problem I'm working on. That's a great way to get ideas, but if you want to come up with 10 or 20 ideas or directions for your company, you need a structured approach that thoroughly scans the range of possible solutions from many different domains.

PwC: Is this a case of someone, you in particular, being incredibly brilliant or determined? How did you come up with these ideas from outside the specific discipline you were working in?

BH: Realistically, no single human could keep in their head all the innovative solutions to problems that humankind has invented. I'm talking about the details that are outlined in document repositories such as patent databases, proprietary lab notes, research publications, operating manuals, and the like across all industries. The secret is to use information technology together with the TRIZ principles. I started using the Invention Machine Goldfire, innovation software from Invention Machine, for exactly that purpose in my first job at Ingersoll Rand. And I continued using it through multiple roles there and other corporations, and I still use it today.

And here's the thing. I was able to get 32 patent disclosures in four and a half years. That was with solar technologies—and I knew zero about solar when I started. It was the same when working on gas turbines. I knew zero about gas turbines when I started.

You want to get your employees to be more effective and to look at information that they might be overlooking. Intelligent software is the best, most efficient way to do it.

PwC: What's the key enabler in software that contributes to structured innovation methods? How do you actually use it?

BH: In our work we did a lot of gas turbine testing and analysis. We stored great amounts of test result information, but we could never find it. It was either buried in a server or it was in a paper file somewhere.

When I first came on board, we had a digitizing program where we scanned 50-plus years of information and digitized it. Once it was digitized, I pointed Goldfire at it. The software reads every single document and puts them into what Invention Machine calls a Knowledge Base. You can do the same thing by pointing Goldfire at Web sites. So then when you say, "I want to know information about fuel nozzles," it gets all the fuel nozzle information. Not only my information from inside the company, but it also gets every public domain piece of information about fuel nozzles. Now I have not just the smartest guy in the company sitting next to me, but I have everybody's information at my beck and call.

PwC: So far this sounds like a standard search engine. Is there more to it?

BH: It's much more precise and tuned to the problem-solving focus on innovation. Go into a Web search engine, type "how to switch power," and see how many hits you get. And then do the same thing with "how to power a switch." Those words are basically the same verbs and adjectives, but they're in two different sentence structures. You're going to get identical hits or pretty close to identical hits with standard search engines.

With Goldfire, you're going to get semantically relevant answers to those questions. And that blows people out of the water.

Then it's going to turn around and ask you, "Do you mean a light switch? Do you mean this kind of switch? Do you mean that kind of switch?" And then when you write "how to switch power," it asks, "Do you mean electrical power? Do you mean nuclear power? Do you mean conversion of mechanical energy to power?"

PwC: Is the only way to take advantage of structured innovation through the use of software?

BH: Both the principles and methods associated with TRIZ and the advanced technologies incorporated into Goldfire offer innovation process breakthroughs. If you're not going to buy the software, then definitely start a TRIZ program and start training people. You can solve problems better, cheaper, and faster. If you want to solve them 10 times faster than that, add the software advantages from technology like Goldfire.

"The secret is to use information technology together with the TRIZ principles."

Powering the innovation life cycle

Several technologies help raise the innovation performance of enterprises.
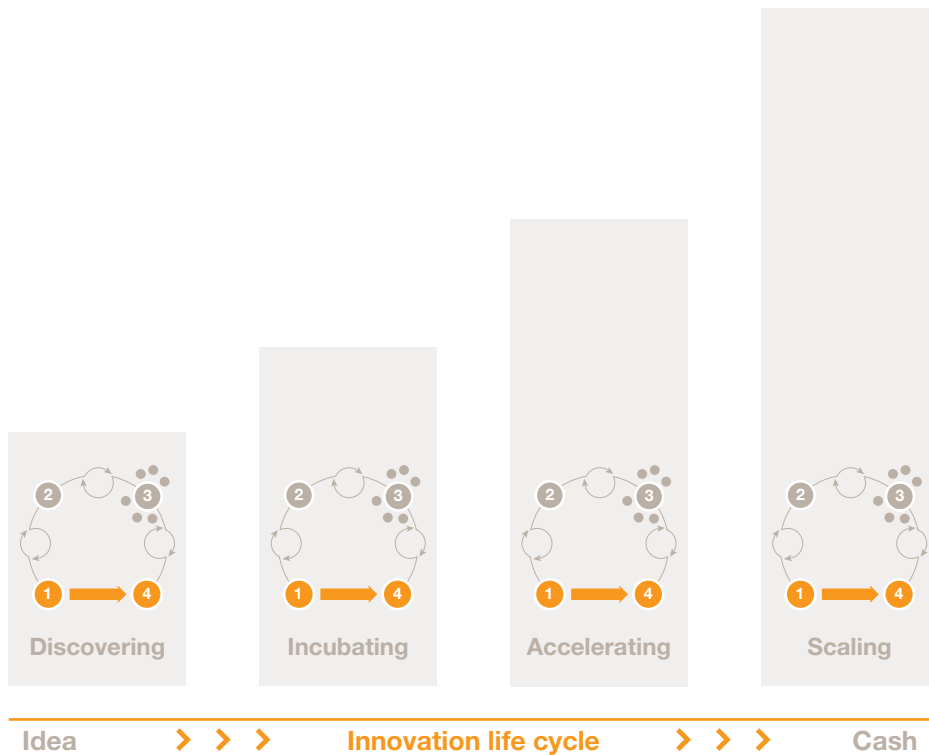
By Vinod Baya and Alan Radding

Innovation remains a hit-or-miss proposition with more misses than hits at most companies. When innovation does occur, luck often deserves more credit than any systematic approach. There are, however, proven engineering and design principles and methods for attacking problems in need of innovative solutions. And there are software applications that treat innovation as another case of knowledge engineering, access, and distribution.

PwC views innovation as ideas turned into successful commercial products and services. As discussed in the article, "Can innovation be disciplined without killing it?," on page 06, enterprises should treat innovation as an end-to-end process—what PwC calls the idea-to-cash process. Framed this way, a series of subprocesses move ideas through stage gates that filter and choose the best ideas; together they form the innovation life cycle. (See Figure 1.) Problem solving is core to moving the process forward at each of these stages, and emerging technologies are playing a role. The ideal innovation process is backed by an idea-to-cash infrastructure that includes people, processes, and software similar to other enterprise processes, such as enterprise resource planning (ERP), human resources (HR), or customer relationship management (CRM).

The first article in this issue of the *Technology Forecast* explains innovation as an end-to-end process and examines the opportunity and potential of this problem-solving approach. The article, "The strategic CIO's new role in innovation," on page 44 explains the CIO's role as a business leader and as the IT leader. This article lays out the essential technologies that make it possible for the CIO to have an impact on the enterprise's innovation capability. Technologies that support this end-to-end innovation process fall into two broad categories:

| Discovering | Incubating | Accelerating | Scaling |

| Idea | > > > | Innovation life cycle | > > > | Cash |

These technologies, alongside an information sharing and collaboration platform, can power the end-to-end innovation life cycle. Figure 2 shows how these technologies map to the framework of structured problem solving that intuitive innovators do naturally.

The CIO should be the principal agent of technology enablement for the end-to-end innovation process, choosing and deploying appropriate technologies. Some useful technologies may already exist within the business units; these, too, should be brought into the strategic mix, regardless of ownership.

Being smart with ideas: Idea management systems

Idea management systems enable the organization to manage the discovery, incubation, acceleration, and scaling of ideas to create commercial value through the development of innovative products and processes. They provide a structured, disciplined approach to managing the innovation process and surfacing metrics to manage the flow and outcomes of the process.

The underlying approach for idea management is not an unfamiliar one. "Just as you track your leads in a sales system, we identified the idea as the starting point when directed work on a particular innovation project begins," says Matthew Greeley, CEO of Brightidea, which develops and sells idea management software. Companies may engage in various activities such as brainstorming, market research, strategic analysis, competitive analysis, and others before an idea is generated or formalized; but for Greeley, the moment the idea first is recorded signals the start of the innovation process.

- **Technologies supporting process**—These solutions allow enterprises to treat innovation as a process and to integrate activities and flows. Two distinct classes of solutions make this possible:

  – Idea management systems help manage the flow of ideas and their evolution, and optimize the idea-to-cash process.

  – Product life-cycle management (PLM) and project or product portfolio management (PPM) systems, often used in the later stages of the innovation life cycle, help manage a portfolio of innovations and related product life cycles.

- **Technologies supporting solution identification**—These technologies support specific tasks and activities all along the end-to-end process. Many function- and industry-specific tools already are in use, such as design environments that include computer-aided design, computer-aided engineering, chip design, and others. However, the focus of this article is on industry- and function-agnostic tools. Solution identification tools help systematize the invention[1] activity of the innovation process. These tools include a combination of structured problem-solving methodologies best represented by the TRIZ family of approaches, and semantic search and knowledge management techniques that support problem solving.

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1 In PwC's terminology, innovation is a process from idea to cash, and inventions are the solutions that address problems at any stage in this process and therefore allow it to move forward.

By digitizing the notion of an idea, the idea management system makes it possible to structure and manage what typically has been considered an ad hoc process. Idea management has been around for a long time in analog form: index cards, scratch pads, and whiteboards are widely used when generating ideas. Not unlike sales leads in the sales process, digitizing the notion of the idea enables decision making, forecasting, and the tracking and management of the idea through the innovation life cycle.

Idea management systems address many challenges in the innovation process. One is the need to filter what could easily become an overwhelming volume of ideas as open innovation approaches allow more and more employees, partners, and customers to participate in the idea generation process. With employees, partners, customers, and others who could potentially offer solutions and suggestions from around the world, most companies would have no way to cope with the sheer volume if idea assessment were entirely manual and flowed through a few people. Idea management systems provide the front end for harnessing and structuring this massive idea flow.

Key characteristics of idea management systems

The core characteristics of idea management systems offer support for capturing, filtering, and assessing ideas, as well as measuring the flow of ideas through the innovation cycle. They also support defining organizational roles related to innovation and managing workflow. Besides these features, the systems include certain capabilities that are imperative for innovation.
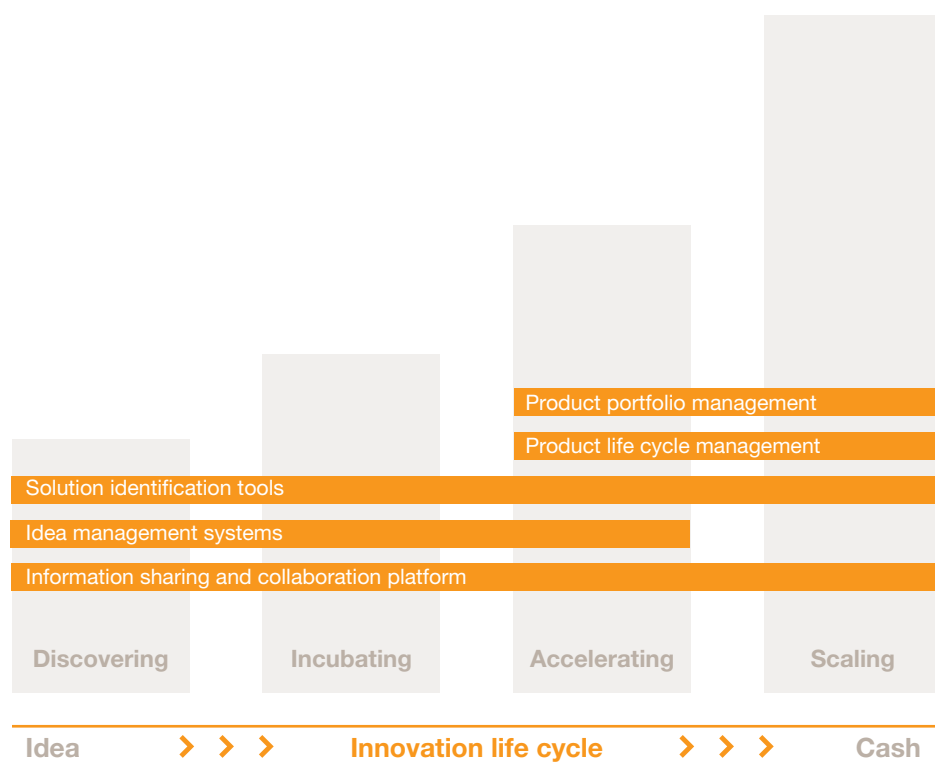
Innovation is essentially a social process. Once suggested, an idea needs people to collaborate on it, and the idea needs to be evaluated, refined, iterated, combined with other ideas, and so on. These tasks make use of various criteria, such as potential value, synergies, market trends,

match to expertise, and relationship to other ideas and existing efforts. There are usually several mechanisms for performing these tasks, and the mechanisms often include social networking aspects such as letting anyone comment and link to other ideas as well as having a formal evaluation group assigned (or several such groups, one per key approval criterion). Capabilities to help the vetting typically include voting, ranking, commenting, and flagging.

Although the idea management process is most easily conceived as moving ideas through a funnel that contains a set of filters, the process is not purely linear and these systems allow trial and error and iterations. Ideas can loop back to previous points in the funnel, as when they are merged with other ideas, or they can be held for future consideration. Figure 3 shows conceptually how such loop-backs happen at all stages of the life cycle, even as the focus moves from discovering to scaling.

The CIO should be the principal agent of technology enablement for the end-to-end innovation process, choosing and deploying appropriate technologies.

Figure 2. Information technology support along the innovation life cycle

Product portfolio management

Product life cycle management

Solution identification tools

Idea management systems

Information sharing and collaboration platform

Discovering   **Incubating**   **Accelerating**   **Scaling**

Idea ❯ ❯ ❯   **Innovation life cycle**   ❯ ❯ ❯   Cash

Digitization of ideas does more than just manage the innovation process. Once recorded, ideas become a knowledge source for the enterprise, whether they are moved forward or canceled. They become information assets that can be reused, refined, or mined in future activities. This characteristic underscores the value of discipline and rigor in tagging ideas for future use. "We made a decision to be very rigorous in how we tagged and built our taxonomy for ideas that went in, so we actually can find things very easily by very specific topics," says Jon Bidwell, chief innovation officer of Chubb.

The systems also should be capable of accepting information from and making information easily accessible to other systems. For example, a Brightidea customer exported data from an innovation campaign to a visualization tool to create a Flash presentation, allowing users to explore the information in a user-friendly manner. This was relatively easy because Brightidea's product exposes data via a REST[2] application programming interface (API). "That never would have happened if there was a 15-step process with three documents and four checkpoints to free up a data set," Greeley says.

Creating an end-to-end innovation process flow depends on the ability to integrate the idea management system with other systems already used to manage products and their portfolios. For example, integration with PLM systems can feed findings from defect analysis and Lean-oriented product refinements into the assessment of related ideas, and can identify ideas for further exploration (a feedback loop that goes beyond the specific project). Or data from CRM systems could be analyzed against proposed ideas to see the overlap between customer pain points and proposed service innovations.

Figure 3. The innovation life cycle is not linear but has many loop-backs.
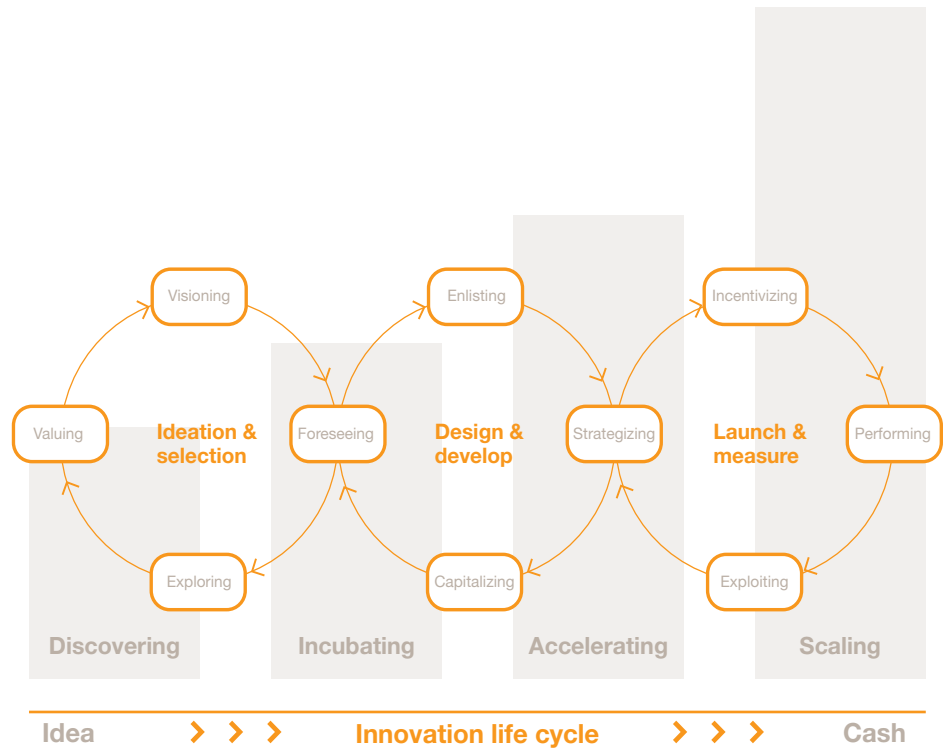
Use of idea management systems

Many organizations have started using idea management systems to structure and manage their innovation processes. The most visible use is in open innovation initiatives where enterprises such as General Electric Company, Cisco Systems, Proctor & Gamble, Dell, Starbucks, and others engage with their customers and the world at large to find ideas. Use of such systems is also on the rise within enterprises, including Chubb, InterContinental Hotels Group, Google, and PwC, for example.

Although rooted in the concept of ideas and their management, such tools enable a larger pool of people to be involved in the innovation process instead of limiting the activity to research and development (R&D) or product development teams. As a result, these systems allow collaboration among top management on strategies the team is developing, as well as collaboration by talent within and outside the enterprise on challenges and opportunities facing the enterprise.

Many emerging and established vendors provide solutions for idea management. Providers include Brightidea, CogniStreamer, ID8 Systems, Imaginatik, PhpOutsourcing Ideabox, and Spigit. SAP and Oracle offer solutions for idea management as part of their solution suites.

Some are offered as on-premises applications and others are offered on the software-as-a-service (SaaS) cloud-based model. CogniStreamer and Ideabox offer on-premises models. Brightidea and Imaginatik offer SaaS solutions. For a sampling of vendors that provide idea management solutions, see the sidebar on this page.

Future of idea management systems

At present, idea management systems focus on early stages of the innovation life cycle, in discovering and incubating ideas. These systems have the potential to evolve into full-blown ERP-like systems for the entire innovation process when they are integrated with other functional applications that span the acceleration and scaling phases of the innovation life cycle. The Brightidea product, for example, allows an organization to trace ideas from their origin through their evolution into proposals and funded projects. Brightidea provides the capability to manage proposals and projects, but the product also integrates with PLM or PPM systems. Imaginatik's product allows integration with problem-solving and prototyping tools, while Spigit's suite allows data integration with various enterprise systems.

The greatest impact idea management systems have had thus far is in reducing the friction in the generation and capture of ideas. As a result, most organizations that use them have a robust collection of ideas from which to further their innovation ambitions. Where many organizations need support is in the execution of these ideas to drive to cash or value. This is where the technologies for solution identification can make a substantial impact.

A sampler of idea management systems vendors

Brightidea Innovation Suite: A cloud-based, end-to-end innovation management product, it uses social networking features to drive continuous collaboration. Modules include WebStorm for idea collection and collaboration in large groups; Switchboard for merging ideas into proposals, developing proposals, and doing multiple-round scorecarding and private collaboration for accelerated decision making; and Pipeline for social project tracking through tasks, milestones, and financial projections.

CogniStreamer Innovation Portal: It supports a framework that uses a collaborative peer-review process combined with other intelligence data (such as page views, ratings, flagging, and tagging) to produce a collaborative filtering algorithm for automated qualitative ranking of the idea portfolio.

ID8 Systems: The software uses game theory to capture the collective wisdom of employees, partners, and customers through crowdsourcing, and it encourages users to select the ideas that would be the best for the organization. A workflow feature allows users to create, update, and manage ideas and allows integration into a user's workflow, workgroup, or existing collaborative infrastructure, such as Microsoft SharePoint.
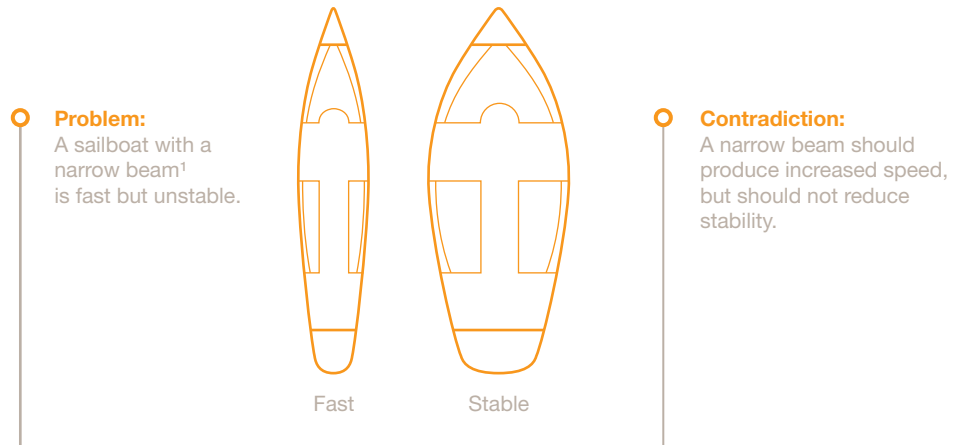
Imaginatik Idea Central: This Web-based application for collaborative innovation and idea management is based on crowdsourcing. It helps focus idea generation on strategic business objectives and helps capture, develop, review, and share those ideas. It has add-on modules for mobile users, intranet portals, external collaborators, and idea warehousing.

Oracle Agile Customer Needs Management: This solution for idea management is part of Oracle's Product Value Chain suite and is designed to manage and automate the fuzzy front-end innovation process by making it easy to capture and prioritize product ideas, customer feedback, and product requirements from internal and external sources.

SAP "Edison": As a tool to capture and collaborate on ideas, "Edison" helps manage, evaluate, and search ideas. It can be used as a standalone tool or with the SAP Portfolio and Project Management application as part of an end-to-end solution that supports innovation from strategy to execution.

Spigit: A suite includes configurable idea templates, role-based requirements and criteria for idea advancement, a set of social software tools, an analytics engine to filter the ideas, the RepUrank scoring algorithm and evaluation tool, and a dashboard that provides real-time activity updates.

Figure 4. How TRIZ inventive principles resolve contradiction in building a racing sailboat and lead to an invention that overcomes the contradiction

Problem:
A sailboat with a narrow beam[1] is fast but unstable.

Contradiction:
A narrow beam should produce increased speed, but should not reduce stability.

Fast   Stable

[1] Beam is the width of the boat at its widest point.
Source: Pretium Innovation

Accelerating and scaling with life-cycle and portfolio management tools

The use of idea management systems and solution identification systems is increasing, but many organizations already use PLM and PPM systems. These tools address the later stages—acceleration and scaling—of the idea-to-cash process. They shepherd the idea through the proposal, design, and manufacturing planning stages.

PLM describes a comprehensive framework of technology and services that permit companies, their partners, and customers to collaboratively conceptualize, design, build, and manage products throughout the product creation life cycle. While the innovation life cycle may focus on idea to cash, the PLM life cycle goes beyond cash to the product end of life. Early in the last decade, PLM became the primary means by which manufacturing companies achieve step-change improvements in product development processes. PLM products generally combine information from multiple systems—ranging from Word documents to computer-aided design (CAD) drawings—with role-based

workflow management to streamline the flow of pertinent information to the various parties, and to ensure everyone is working from the most recent information.

Trends in global product development, the need for unified data management, and the necessity of rapid collaboration across the supply chain drive the adoption of PLM systems. The definition of PLM continues to expand to incorporate the entire new product development and launch (NPDL) process, and best-of-breed ERP and CAD-centric PLM vendors are competing for the new opportunities.

While PLM systems focus on a particular product, PPM systems look across the collection of product innovations and help companies focus resources on the products that will provide the highest value while managing the risk and uncertainty inherent in bringing new products to market. This is made possible through centralized product planning, cost estimation and forecasting, financial modeling, and creating information transparency throughout product life cycles.
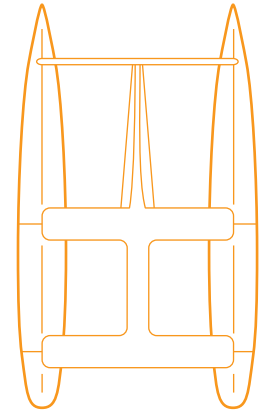
A mix of traditional IT vendors and specialist firms provide PLM and PPM solutions. PLM and PPM systems are available from many established vendors, such as Dassault Systèmes, IBM, Oracle, PTC, SAP, and Siemens.

Executing ideas: Solution identification tools

Problem solving is a core activity along the entire innovation process, as Figure 1 illustrates. Problems are overcome by novel solutions, and any technology that expands support for solution identification will raise overall innovation performance. Solution identification tools take two forms. One is the theory and methods for systematic problem solving as a discipline. The other is the use of semantic knowledge management techniques to make the techniques and problem-solving capabilities accessible to all involved in the end-to-end innovation process.

Theory of Inventive Problem Solving

TRIZ is a mental discipline and method that supports systematic problem solving. Developed by Genrich Altshuller in Russia more than six decades ago, TRIZ is the best known inventive problem-solving approach. (It also is known as the Theory of Inventive Problem Solving [TIPS].) There are related methodologies and simplified versions of TRIZ.

These methodologies capture the principles behind known successful inventions. They are a result of detailed analysis and codification of millions of patents around the world and the knowledge related to them, which spans a large portion of known technical, engineering, and other disciplines.

In the days before software support, TRIZ users were trained to identify a general principle embedded in a specific design problem. The method then suggested a set of general approaches to the abstracted design problem that should be considered first as potential solutions. Thus in TRIZ, invention is using the general solution in a novel way, as it applies to the specific problem.

TRIZ solves problems by focusing on contradictions. In any system, a contradiction occurs if the increase in a useful function in one subsystem creates a harmful outcome in the same or another subsystem. For example, the need to increase strength contradicts the goal of reducing weight of the system. TRIZ works best when the problem can be phrased as a contradiction.

One classic TRIZ example involves contradiction in boat design: faster boats require narrower hulls, but more stable boats require broader hulls. In an interview with PwC, Peter Hanik, president of Pretium Innovation, describes how TRIZ principles anticipate the solution. In this case, the *separation* principle calls for separation followed by integration. Here's what that means in practice: the narrow hull is produced at the subsystem level while the harmful side effect, compromised speed due to a broad beam, is counteracted at the system level. Integration means to establish a relationship between elements when the separation is performed. The result: a catamaran, which is a remarkably stable and very fast boat. (See Figure 4.) TRIZ results in a design that resolves the contradiction, making compromise unnecessary.

> *"Just as you track your leads in a sales system, we identified the idea as the starting point when directed work on a particular innovation project begins."*
> —Matthew Greeley of Brightidea

Managing knowledge to support problem solving

The key to using TRIZ or related inventive problem-solving methods is recognizing patterns of similar contradictions and discovering solutions based on knowledge resident in patents or the experience of the enterprise. Modern software, particularly those that use semantic knowledge management, can considerably simplify this analysis and pattern recognition task, helping to abstract the problem with function modeling or root-cause analysis support. Such software also can simplify the pattern-recognition step through a keyword search augmented to reflect the cause-and-effect nature of solutions. It then finds specific instances of related problems and solutions from all industries and conceptual domains, positioning them for consideration by the problem solver.

As a result, the knowledge sources become a valuable innovation asset in their own right. By combining semantic knowledge with search, people can "find very quickly and precisely the concepts that they need to understand so they can make good decisions about how various potential options and ideas map to these different types of [business impact] metrics," says James Todhunter, CTO of Invention Machine.

Building an enterprise innovation life-cycle platform typically will involve restructuring and managing information to support innovation. Building such a platform involves the introduction of knowledge databases with strong semantic analysis components tuned to digest and properly index documents most closely related to invention: patent repositories, lab manuals, research papers, Web sites, and so on. Tools that bring together these capabilities include Invention Machine's Goldfire and software from Ideation International and IDEACore.

Goldfire's Insight module supports research activities aimed at innovation. It uses semantic research technology to provide direct access to concepts as problems and solutions from inside and outside the company. The module creates a semantic knowledge base from all available knowledge, personal file systems, lab notes, Web sites, technical literature, and others. Insight captures an organization's technical knowledge, past experience, and expertise, and makes it available to others in the organization when they need it. When it indexes the sources, Goldfire tries to understand the cause-and-effect relationships between the concepts. It can be accessed using a natural language interface. Users can find solutions to their problems from past patents and thousands of technical documents, identify relationships between concepts, and find precise answers to their innovation challenges.

Goldfire includes support for many innovation methods used across the innovation life cycle. Methods such as Value Engineering and TRIZ focus on problem definition and encourage creative thinking. Tools that perform root-cause analysis and device or process analysis aid in problem identification and resolution, while rich patent analytics help organizations see beyond current markets and technologies and identify solutions from other domains.

Some organizations develop their own solutions. IDEO, a global design firm that helps clients innovate and grow, has a knowledge capture and sharing system called IDEO Tech Box[3] to store past problems and their solutions. Tech Box is a combination parts and materials library, database and Web site, and organizational memory. It allows IDEO to archive its experience gained from work in many industries and share it across its worldwide network. The Tech Box is a valuable resource that designers and engineers use to gain inspiration, break out of a holding pattern, or avoid reinventing the wheel.

Conclusion

When innovation is viewed as an end-to-end process that spans the life cycle from idea to cash, a range of emerging and established technologies play a role in raising the innovation potential of the enterprise. The technologies identified in this article do two things. They systematize and structure key activities all along the process. And they reduce friction and bottlenecks at key stages in the innovation life cycle.

Idea management systems simplify and streamline the process of surfacing, collecting, and reviewing large volumes of ideas. By digitizing the notion of ideas and creating transparency around the progress of any idea, these systems structure what has been an ad hoc process. In reducing the friction in the generation and capture of ideas, the bottleneck moves to how enterprises will execute on the ideas.

The execution is tied directly to the role of problem solving. Problem solving is core to how innovation happens and progresses. Inventive problem-solving methods such as TRIZ enable organizations to have a systematic approach to surfacing, defining, and solving problems.

Semantic knowledge management techniques make these methods accessible to many more people and tap into problem-solving knowledge in patents, within the enterprise, and in the broader technical and other communities. In addition to problem solving, execution also requires robust support during the accelerating and scaling stages of the innovation life cycle; here, the use of existing PLM or PPM products play a role.

Together these technologies provide some of the underpinnings for the technology infrastructure to support the end-to-end idea-to-cash process.

When innovation is viewed as an end-to-end process that spans the life cycle from idea to cash, a range of emerging and established technologies play a role in raising the innovation potential of the enterprise.

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3   http://www.ideo.com/work/tech-box

Managing innovation from concept to cash

Matthew Greeley of Brightidea details how openness and social software features create opportunities for IT to innovate.

Interview conducted by Vinod Baya and Bo Parker

PwC: Could you please describe your company and the value it is creating for your customers?

MG: Sure. Brightidea was founded about 11 years ago. We're a longtime leader in applying software to the challenge of innovation in a large organization. Currently our solutions are in a SaaS [software-as-a-service] offering and therefore have a multi-tenant architecture and subscription business model. Where we differentiate is that we have a very social platform, so our product is Facebook-like. We believe innovation is a social activity, and until software became social, it was impossible to really try and automate the innovation process.

We just released our Innovation Suite, which we believe is the first-in-the-world case of a seamless flow from idea to launch of a product. The suite has three products—WebStorm, Switchboard, and Pipeline—that cover the entire innovation process from the moment an individual has an idea until the organization realizes that idea as cash. WebStorm handles ideas, Switchboard handles proposals, and Pipeline handles the development of projects, which could be products or cost savings improvements.

PwC: How do your products help enterprises manage the innovation process?

MG: Our company is named Brightidea, and the insight we had when we started was that the object or the element of an idea is the atomic element of the innovation process. Every innovation starts as a new idea.

We set out to build a system that would track those elements. So just as you track your leads in a sales system, we identified the idea as the starting point when directed work on a particular innovation project begins. There certainly can be activities you do ahead of having an idea. You do a lot of strategy, road mapping, and market research, and you look for customer insights. A whole bevy of activities happen ahead of that idea, but we identify the moment in time when an idea gets recorded. It can be a core concept, it can be on a mobile device, or it can be through a browser submission or something like that as the start of the innovation process.

Matthew Greeley

Matthew Greeley is founder and CEO of Brightidea, a provider of cloud-based innovation pipeline management (IPM) software. Prior to founding Brightidea, Greeley consulted for Wrenchead.com, helping the company raise more than $100 million in venture funding, and he co-founded Silicon Valley enterprise software provider Alyanza Software. Greeley began his career at FMK Advisors, an East Coast hedge fund, where he focused on marketing and fund-raising.

In this interview, Matthew Greeley discusses how CIOs can enable innovation by focusing on the end-to-end process from concept to cash and opening up data and other IT capabilities.

Let's think about what happens after you have an idea. You start linking ideas and clustering them. You allow people to collaborate and you allow them to vote, to prioritize. Then you move into this proposal framework where people are refactoring the scattered data points of the ideas into a business proposal, and they're looking at competition and market size and the general business parameters. There are tools to create scorecards and prioritize with expert reviewers at that level. Then you move into a project that is funded, and that can either hand off to an existing portfolio management system or you can continue the project within our Pipeline product, which is a social project management application and is a lot like Facebook.

You can follow a particular project, and you can get all the updates you want if you're following that project. So you get a lot more visibility and transparency, and executives can keep their eye on what's going on with the projects that matter most to them.

PwC: A lot of enterprises are looking to their CIO for innovation, to help grow the business, and to create new value. What do you think CIOs can do with respect to innovation?

MG: IT can definitely drive innovation, and the invention of FedEx tracking numbers is a great example of it. The company went all in to build the systems necessary to track packages in real time. A transformational customer experience resulted from it, and it's a world-class company. IT can definitely drive specific innovation projects if they're thinking strategically and if they're seeing their role to innovate and enable innovation.

"An idea is the atomic element of the innovation process. Every innovation starts as a new idea."

The nuanced view I have is that IT's role increasingly will be to select a platform for managing innovation and making the necessary enterprise-wide decisions. I think some end up shortchanging the innovation for some features of a social platform. Instead, they must be really clear about where they will get their competitive advantage and what the real benefit of these tools is. Our view is if you just lay in a social platform, you might get some innovation, but if the tool isn't specifically designed for that, you're not going to tap the innovation potential of the enterprise.

If the tool collects only ideas, it's like a sales funnel that collects only leads. There's no way to move the leads forward to contracts. CIOs need to get smart quickly on innovation, as they're the ones in the organization who understand how technology evolved and how to deliver on an end-to-end process. They understand that adoption of new systems isn't trivial, that they must work with business champions and specific business units and specific roles to show the value.

PwC: What can CIOs specifically do to spur innovation?

MG: Historically, IT groups were fiefdoms unto themselves within the organization, and I think there's huge potential to open up the data sets. For instance, I referred to FedEx earlier: simply by making available to end customers in a very safe and secure way the data that the organization already had, the company transformed the customer experience.

We work with companies whose whole product is data. We work with The Nielsen Company and Experian, and they're constantly reformulating how they repackage the data. Experian does credit reports, and they can do credit reports for the auto industry, for home loans, or online buyers, and so forth. And they can do bill consolidation. They're constantly looking at ways to repackage the data. Freeing data in an intelligent user-driven or customer-driven way is a really important trend.

PwC: Could you talk a little bit about how an ethic of such openness has penetrated your company and what are the lessons for CIOs?

MG: It is very straightforward. You can go to ideas.brightidea.com, and that's where our customers tell us what they want to see in the next version of our products. It's wide open. Our competitors can see it. They often do. We view the value of openness in terms of the relationship we have with our customers, the innovative ideas and agility we're going to get, and the ability to listen to the customer more intimately. We view that as a huge value, and that's why we incur the risk of our competitors trolling through there and seeing what they can find.

From an architectural standpoint, we have a full-blown REST API [representational state transfer application programming interface]. Basically, every data element within our system can be exported and pulled out, and customers have done things that have just blown us away. For example, GE had a product design group use our API to pull out all the data from this global collaboration, and they did a Flash visualization of all the data. That never would have happened if there was a 15-step process with three documents and four checkpoints to free up a data set.

You have to be smart, obviously. We don't want someone from one enterprise getting into another enterprise's data, but once you are in this Net-native configuration, where you assume the information can flow like water between systems, that alone is a trigger for unleashing creativity and lowering the barrier to people trying new things. If it takes someone two hours to do something or it takes them two days to do something, the chance of them doing it falls off precipitously, just because of the pure friction of the process and getting it done.

That's how we approach the transparency, openness, and extensibility as well. We have all sorts of hooks to other third-party systems, such as portfolio management systems, agile project management systems, and issue tracking systems, and we've built in that extensibility from day one. I think CIOs should lean on their larger enterprise vendors and say, "I need ways to free up my data in a smart way." There was this dream that you were going to have everything on one platform and you'd be able to view it in the slice you wanted to view it in. But the reality is that new services emerge every quarter. It's just a dream that you're ever going to have all the data on one system.

So it's better to accept that chaos and make sure the systems that you do have are open and you can rip data out of them. One of our customers has a dashboard where they have a unified view of their customer, their bookings and billings, all their support information, and all the ideas that those customers are feeding them for their next-generation products. That's only possible if you buy into this openness and extensibility paradigm.

PwC: On the mobile and tablet platforms, we are seeing a large number of apps being delivered. Do you think the barrier to developing applications is getting lower, and what does this mean for IT-driven innovation?

MG: I definitely agree that the barrier is being lowered, and that openness enables that to happen—not just the development time to be compressed, but then the overall process time to be compressed at orders of magnitude. Some folks in the product development R&D group at Kraft will take a picture if they see something. That picture immediately is in a shared space where other people can collaborate on it. In the past, they did innovation days once a year where people would get together and have a big poster board with their new product that they're developing.

In terms of creating value, you would think that when processes have been reduced to days, there's not much room left for transformational or quantum-leap breakthroughs in them. But now we're talking about processes that are happening in minutes, so I think the mobile and the open data really enables that.

But to come back to another point, I think simple REST-based APIs are just table stakes for anyone in the cloud. It's as important as in a retail store where you have a sign out front. It's expected, and you'll throw people off if you don't have that. Our customers ask us to integrate with customer support systems, their project management systems, portfolio management systems, and financial accounting systems. For some of those, we see recurring integrations.

It's just we're all peers. There's a fluid flow of information that can go back and forth if our platform is designed well, if we protect the data that needs to be protected, and if we expose the data that can be exposed.

PwC: Most CIOs of large enterprises are not starting fresh with a greenfield in terms of being Net-centric or in the cloud. They have a mix of legacy, Web, SaaS, and so on. How do they get more like you in a safe and secure way?

MG: We have a phrase we use internally where we say, when you're first getting started, don't do heart surgery. Polish a couple of fingernails. It means you don't go into the beating heart of the business and try and swap that out. It just doesn't make sense. However, both SaaS and social software have enabled new applications, so things that you never even had a system for—innovation being one of them—are good places to start. You start on the fringes, polishing a fingernail. You'll still get ROI [return on investment], payback, and all that other stuff.

As you're easing into software as a service, you're easing into this open, infinitely integratable environment. The CIO may not even know that someone in the department is integrating system A with system B, because they're both on the cloud and they're using a local resource to do the hook-up. I think you always start at the periphery, and then you work your way toward the center. But it's going to be a long time and, in my view, probably will never happen where everything goes into the cloud. There's talk of private clouds and all, but frankly, I see many CIOs worried about having as much heterogeneity in the cloud as they have right now.

> *"IT's role [in innovation] increasingly will be to select a platform for managing innovation and making the necessary enterprise-wide decisions."*

PwC: Do you ever see a future where solutions might extend to a point such that if the idea can be realized through IT, the system could trigger prototyping and solution extension, rather than focusing on being a system of record for ideas and their flow?

MG: I definitely think so. Even in our current usage, we have people using our product as a front end to the IT portfolio—helping them determine what projects IT should be working on and helping them open their ears to their internal customers. I've seen IT organizations deploy our product as a service model, where they're the center of excellence for the innovation process and they're providing the tools the same way they provide e-mail or something else to the organization with the best practices to actually get results. I've also seen IT organizations use our product internally, where they're getting ready to roll out a new desktop image across a 60,000-person organization and IT lets people chime in on what they like or dislike about the current desktop image before IT locks down the spec.

IT is a key execution engine for new ideas, proposals, and initiatives. I think IT gets the process of adopting new technology. They realize that it can be tricky and that they must find champions in the world and within their organizations that will adopt them, so IT is actually extremely well situated to be a driver of the innovation process and the adoption of these tools.

Systematic problem solving

James Todhunter of Invention Machine shares how systematic methods for problem solving and knowledge management can help enterprises sustain innovation.

Interview conducted by Vinod Baya and Bo Parker

PwC: Could you please describe your company a little bit as well as the core product and the challenge it solves for your customers?

JT: Absolutely. Invention Machine helps Global 5000 manufacturing companies drive sustainable innovation. While most companies profess their commitment to continuous innovation, very few of them know how to go about actualizing innovation in a consistent, repeatable way. Invention Machine gives companies a road map to high-performance innovation— first identifying an organization's critical innovation initiatives and communities, and then integrating innovation best practices and infrastructure to make innovation a sustainable engine for value creation.

Our innovation intelligence platform, Invention Machine Goldfire, combines a number of proven innovation methodologies with very rich global content relative to our clients' lines of business in general technology and science. We also have patented semantic technology for research and high-precision concept identification. These various elements of Goldfire help companies drive their innovation initiatives in a number of ways. For example, Dutch Royal Shell

accelerated its entry into new energy markets by using Goldfire to help discover new methods for biofuels production. A large medical device company is redefining its new product development process using Goldfire to knowledge enable its innovation workers and thereby drive much higher productivity, much richer IP generation, and much faster development of competitive value-driving products.

Our clients use Goldfire to help them establish repeatable, predictable methods of innovation to drive many different aspects of their business.

PwC: What are the methodologies that you include in your product?

JT: We essentially have a set of 14 out-of-the-box innovation tasks, as we call them. These are solutions we've developed by working with our global clients and analyzing their needs relative to innovation and the key tasks that innovation workers do in their organizations. Within the software, we can provide a repeatable framework to address these specific innovation tasks.

James Todhunter

James Todhunter is the CTO of Invention Machine Corporation, where he is responsible for the company's technology strategy and execution. A seasoned innovator and inventor, Todhunter works on the front line of innovation and has more than 30 years of experience in software technology and management.

In this interview, James Todhunter details how the Invention Machine Goldfire software blends innovation methods and semantic knowledge capabilities to provide problem-solving support during the innovation process.

For example, one category in innovation is market research, another category is new product development, another category that we address is existing product improvement and enhancement, another category is risk management, and then the final category is IP [intellectual property] management. Each of these different high-level categories does specific things that people must accomplish on a regular basis.

You might need to examine potential new markets and understand what the opportunity is. How does that opportunity relate to your business from a standpoint of fit, feasibility, and financial practicality? If you're a product engineer looking at an existing product line, you might need to look at issues such as a new competitive challenge. How do you make sure your product line is going to address that challenge? Or how do you improve your product line to meet new government regulations?

From the IP perspective, you might need to understand how to erect the proper wall to protect your intellectual property. Or, if you are blocked from entry into a new market by a competitive IP element, how can you find alternative technology configurations that allow you to sidestep that roadblock so that you can get into the market but at the same time avoid any kind of exposure from patent infringement? These are just examples of some of what we would call the innovation tasks that people must do. In Goldfire, we provide defined methods of accomplishing those goals.

PwC: What are the solutions that support these methods? Where does TRIZ[1] fit in?

JT: To support the different innovation workflows, we provide lots of different tools in our solution. For example, on the quality side, different standard approaches include failure mode, effects, and criticality analysis [FMECA], HAZOP [hazard and operability] if you're in the chemical industry, and so on.

Another innovation-specific methodology built into the platform is the one you mentioned called TRIZ. It's just one of a number of tools that the Goldfire innovation platform leverages to help make innovation and knowledge workers more effective.

TRIZ recognizes and matches patterns on what is called technical contradictions. As a general capability, it also includes other ways of examining, understanding, and solving a problem. Specifically, it includes this method called Su-Field Analysis, which is a form of functional analysis of engineering systems. Goldfire provides a toolkit around functional analysis modeling as well as functional simplification, which has been one of the other TRIZ tools of value in the innovation discipline.

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1   TRIZ, which originated in Russia and was created by Soviet inventor and science fiction writer Genrich Altshuller, is also known as the Theory of Inventive Problem Solving. The theory includes a practical methodology, tool sets, a knowledge base, and model-based technology for generating new ideas and solutions for problem solving. http://en.wikipedia.org/wiki/TRIZ

PwC: If you think about the end-to-end process of idea to cash, where do your solutions fit in that process and what technology are they using?

JT: As I talk to leaders in global corporations about where they see challenges, I don't hear a lot of people complaining about the ability to generate ideas. What I hear mostly is, "We've got tons of ideas. Everybody's giving us ideas. What we lack is the ability to filter the ideas, to really be able to understand how to focus on the ideas that are going to have the greatest potential. And then, given that we've identified those ideas, how do we move from an idea to an actual deliverable concept to delivered products?"Often, people use Goldfire to help them identify and focus on what they need to accomplish. When you look at an idea and the road toward a deliverable concept and then eventually a delivered product, the eventual product needs to fit certain metrics relative to alignment with the competencies and strategy of the corporation. It needs to fit relative to revenue and profitability generation, or contribution to margin, or feasibility and practicality to manufacture.

Goldfire helps companies address those issues. One of the three components I mentioned of Goldfire is a state-of-the-art semantic research capability. It is the ability to look at various streams of internal as well as external sources of information— things from their industry, from outside their industry, on social media channels where discussions and conversations about their products and their marketplaces may be occurring— and be able to find very quickly and precisely the concepts that they need to understand so they can make good decisions about how various potential options and ideas map to these different types of metrics.

> *"At the end of the day, when you look at how high-value innovation occurs, it really is the notion of synthesizing information in a specific context of a business problem."*

PwC: If tools need to support the end-to-end innovation process from ideas to cash, what capabilities do they need?

JT: Lots of different constituencies are involved in the entire innovation process. To move beyond just simply having pockets with individuals who may drive the occasional accidental innovation per se, to establish a repeatable and predictable environment of innovation, and to build a healthy and active community of innovation within the enterprise, you really must look at all those constituencies and understand two things. One, what are the roles of those constituencies and what are the specific paths they follow to contribute to that value-creation process? And, two, what kinds of information do they both consume and produce in this process?

At the end of the day, when you look at how high-value innovation occurs, it really is the notion of synthesizing information in a specific context of a business problem. Fundamentally, that means that organizations must bring together these different elements of reliable methods that they can equip their knowledge workers with. But organizations also must equip their knowledge workers with knowledge— knowledge that is not readily accessed today. When you do that, you start to create an innovation intelligence ecosystem that allows each individual knowledge worker, based on their role, to have optimal access to information on a just-in-time basis to help them drive forward their contribution.

PwC: What role do you think the CIO and the IT organization could play in innovation?

JT: I think the CIO and the IT organization have a tremendous opportunity these days to help their company drive innovation. In the past, a lot of companies viewed IT as an opponent of innovation, and that is sad, because IT is really in the catbird seat to help drive innovation.

Most companies today lack a collaborative infrastructure for innovation, and they really need to put one in place. In doing so, companies should start breaking down information silos and establishing the mechanisms that allow broad cross-organizational leverage and reuse of knowledge. They need to take the information that's locked up statically in different data stores and mobilize it. IT is in the perfect position to drive that, and that's why IT has this great opportunity. IT can look at putting in place the information-sharing policies and driving those within the corporation to really help these organizations.

IT can evaluate what are the state-of-the-art solutions that will help people use that knowledge most effectively. CIOs can ask themselves, what are the needs in my organization? If mine is a global corporation, do I have people in English-speaking countries and, let's say, French-speaking and Japanese-speaking countries who are creating local documents that contain important technical content I want to be able to share across those regions? How do I do that? These are some of the problems that IT could be looking at. If I want to create an infrastructure to allow both passive and active collaboration within my organization, how can I support that? All these questions have a strong IT element to them as an enabling factor in helping an organization drive innovation efficiencies.

PwC: Are you sometimes concerned that you would be seen as part of the failed knowledge management wave of technology that seems to have come and gone?

JT: That isn't a concern. In the past waves of knowledge management, people were forced to create taxonomies of information that could then be published to user communities. The reality was that those taxonomies never worked. They weren't transparent to the user communities, as they were always developed by someone else. They didn't map to the way people thought, and they didn't map to the way people were having conversation and dialogue, so essentially past knowledge management efforts didn't give people access to information in a useful manner. One of the things our semantic technology enables is the ability to not think about that problem.

When people deploy Goldfire, they don't have to think about creating taxonomies or how to organize the information. Goldfire's semantic technology allows the data to essentially describe its own taxonomy. And, because it's coming directly from the content generated by the user community, that taxonomy is in their language. It's structured the way they think about information, and that makes information access seamless. Additionally, because the semantic technology is driven around the concept of answering people's questions, users typically never need to browse a taxonomy.

PwC: All users now are accustomed to Internet search engines to look for information. Can you contrast how Goldfire would answer questions differently from how the popular Internet search engines would answer the same question?

> *"[Companies] need to take the information that's locked up statically in different data stores and mobilize it. IT is in the perfect position to drive that."*

JT: If we look at the search aspect, which is only one dimension of Goldfire, Internet search engines are optimized for a different audience. The vast majority of users are consumers and not necessarily product engineers or product marketing people, and so a lot of the usage of language and hence the influences that affect the ranking algorithms to deliver information are skewed in a different direction.

If I use my favorite Internet search engine and I say, for instance, I need to know about heavy metal, I can type in "heavy metal." I'm going to see a lot of information about rock-and-roll bands, but as an engineer, I may be more interested in specific elements and what their effects are and so on. It's an entirely different orientation.

We have designed our solution for the users in business and for their innovation problems. The semantic search has been trained on tens of millions of technical and business documents.

On top of that, Goldfire is an innovation platform. It's not just a matter of using a search engine. Let's say you're an engineer and you've been told, "This product of ours has a bearing assembly that is failing prematurely. What's going on?"

One of the first things you might want to do is ask, "What could be happening? Where should I look?" Maybe you'll go through a process of root-cause analysis. Often it can be a hit-or-miss issue, because you might not have the specific domain expertise. There are a lot of reasons why you might not think of everything.

You can ask Goldfire to participate in your root-cause analysis as a virtual subject matter expert. So when you have an issue in your analysis such as a seal that might fail, you can ask Goldfire, "What could be causing seal failure?" And you can do that without ever leaving the context of your root-cause analysis. If you say, "Help me understand what might be a potential cause of seal failure," then Goldfire will automatically present you with a classified and categorized list—based on global literature—of documented and understood causes of seal failure around all the different issues and categorize them according to their potential relevance to your problem. A simple search engine can't deliver that kind of capability.

The strategic CIO's new role in innovation

Innovation is the next frontier for all CIOs, and now is the time for the CIO to prepare and take action.

By Vinod Baya, Galen Gruman, and Bud Mathaisel

After years of nearly 100 percent focus on cost-cutting due to the recession, company boards are now pushing their organizations to find ways to grow the business. In fact, most CEOs are looking to gain both efficiencies and differentiation at the same time. In a recent survey of CEOs conducted by PwC, 80 percent of CEOs believe innovation will drive efficiencies and lead to competitive advantage. (See Figure 1.) For most of them, technology is one way of capturing both. Close to 70 percent of CEOs are investing in IT to reduce costs and become more efficient, while 54 percent are also funneling funds toward growth initiatives. This sentiment is not limited to any particular industry sector, such as high-tech. It applies to enterprises of all sizes in all industry sectors.

As a result, CIOs increasingly hear demands to be "more strategic" and to "add value" through the adoption of mobile technology, social networking, and the analysis of customer and market shifts—all under the guise of enabling or even leading innovation.

But innovation is not based on technology, even if technology is used in innovation. As the article, "Can innovation be disciplined without killing it?," on page 06 explains, core to innovation is solving problems to create better products and market results. The CIO can aid innovation by scouting for useful technologies and by applying technology to improve existing processes. (See the article, "Powering the innovation life cycle," on page 26.) But this has long been part of the CIO's charter.

To add more value and become more strategic, the CIO can help to develop and execute an end-to-end innovation process in which innovations are more likely to be discovered, better assessed, and better converted into profits—what PwC calls the idea-to-cash process. CIOs can contribute in two distinct areas:
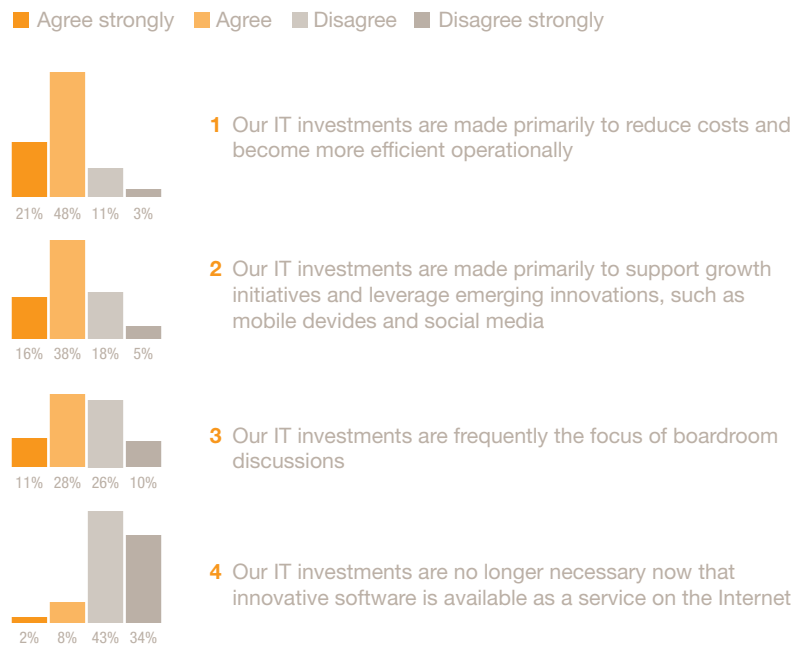
- Help drive the creation and management of the innovation process, as a key member of the executive committee and thus of the strategic business management

- Put together and implement the technology on which the enterprise executes much of the innovation process

CIOs should be comfortable with the second area because of their experience implementing enterprise processes such as enterprise resource planning (ERP), supply chain management, and order-to-cash. Some CIOs are familiar with the first area (perhaps not in an innovation context) if they have experience in business process reengineering or have gone beyond the technology implementation and helped the business leadership think through the processes. The CIO organization's experience in helping to design and then implement earlier process-enabling systems makes it a natural group to take on the innovation process.

No other enterprise unit typically has the expertise to help digitize and rationalize business processes across functional boundaries and the competencies to source and deploy the technologies that need to be brought together to weave the siloed processes into an effective whole. If the CIO organization has a reputation for creating step-change improvements in the execution of key business processes, that's all the better.

21% 48% 11% 3%

1 Our IT investments are made primarily to reduce costs and become more efficient operationally

16% 38% 18% 5%

2 Our IT investments are made primarily to support growth initiatives and leverage emerging innovations, such as mobile devides and social media

11% 28% 26% 10%

3 Our IT investments are frequently the focus of boardroom discussions

2% 8% 43% 34%

4 Our IT investments are no longer necessary now that innovative software is available as a service on the Internet

Source: PwC 14th Annual Global CEO Survey

Designing and implementing the innovation process

The design of the end-to-end innovation process comes first, and that's a role the CIO should undertake as a member of the management team—even though it is not strictly a technology role. It's a strategic business role—exactly what more companies are asking of CIOs.

Few companies consider innovation to be an end-to-end process; most still think of it as the eureka moment. So the essential first step is to accept that having an innovation process requires an enterprise transformation designed to bring consistency to ad hoc, decentralized business processes.

This is a business process reengineering effort. The innovation process moves through stages as shown in Figure 2 and discussed in the article, "Can innovation be disciplined without killing it?," on page 06. These stages lay out the progression of innovation from an idea to cash.

End-to-end transformations have occurred before, and the best-practice patterns are known. Before business activities are reconceived as end-to-end flows, the typical pattern includes local, not global, process optimizations with staff interventions when work crosses functional boundaries; multiple distinct and inconsistent terms for similar business entities; and an inability to predict how changes in one part of the enterprise will impact others. When organizations set out to transform siloed, suboptimal processes into seamless, efficient end-to-end enterprise processes, they focus on four deliverables:
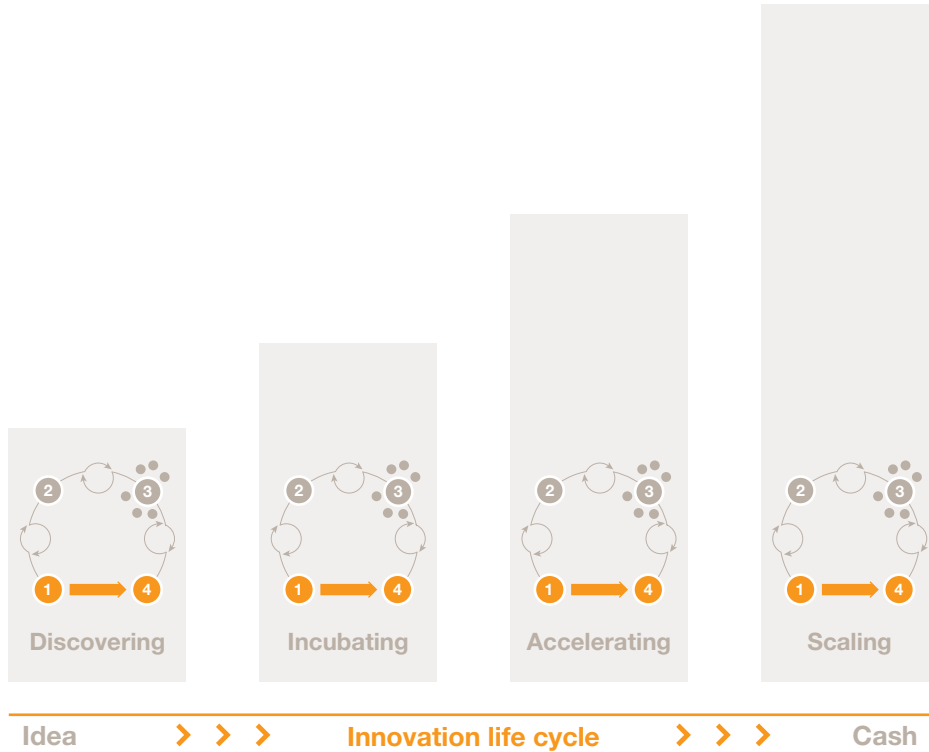
• **Common nomenclatures**—A semantically rich and meaningfully rationalized terminology that accounts for all business unit perspectives is essential. Expecting diverse areas of the business to agree on important issues, such as process design, is impossible if they don't speak a common language. Innovation is rarely treated as an activity that requires a common nomenclature. Research and development (R&D), sales, market research, partner relations, and other units each typically use their own vocabulary for the activities that precede, inspire, and create innovation. To achieve an enterprise-wide, end-to-end innovation process, you need a common nomenclature, one that emphasizes the terms used to define problems and solutions.

• **Digital interfaces**—Computer-based digital interfaces that replace human mediation are building blocks for any end-to-end business process, including innovation, because the process typically flows in and out of more than one business unit. Because most companies do not see innovation as being susceptible to end-to-end redesign and management, even companies that have idea management systems find that ideas pile up at the first stage— initial selection. That's because the ideas are not digitally integrated with the selection process, much less with design, prototyping, alpha and beta testing, and other stages in the flow. You need digital interfaces between each stage in the end-to-end innovation process, not just at the beginning or the end of the idea funnel.

• **Introduction of technology-enabled new processes**— Information technology complements rather than replaces human intelligence. Work that dates from Hammer and Champy[1] in the 1980s shows that introducing technology to execute tasks that people aren't particularly good at leads to radically improved end-to-end processes. Adding data feeds from the business use of credit cards into expense reports is a great example: far fewer errors and omissions occur when this task is computer mediated. New process opportunities in innovation are built on systematic problem solving as the core activity in each stage of the idea-to-cash life cycle. Certain mental disciplines with proven value to innovation are too complex for the majority of staff to easily acquire. Technologies are emerging that can address this challenge, enable new innovation processes, and deliver more and better innovations.

Figure 2. The end-to-end idea-to-cash process is the life cycle of innovation that moves through four key stages. The height of the bar suggests the amount of resources an enterprise might need to commit in any stage.

1 Michael Hammer and James Champy, *Reengineering the Corporation: A Manifesto for Business Revolution* (HarperBusiness: June 5, 2001).

• **Continuous monitoring and improvement**—The history of process reengineering shows that enterprises with successful end-to-end processes don't just install and forget. They institute measurement and analytics at meaningful points in the process, and they constantly monitor and improve. For example, the days of sales outstanding and the cash-to-cash cycle have become key measures of end-to-end processes against which companies benchmark themselves. Because innovation is rarely measured this way, companies cannot know whether changes that target innovation performance have the desired effects. Deciding on appropriate metrics, capturing them, and sharing them will set the stage for ongoing improvement of the innovation life cycle.

How does innovation differ from previous end-to-end process implementations? The overall innovation process is not linear. Rather, it is iterative with a great deal of trial and error, and only one in a hundred ideas will complete the cycle. CIOs will need to make thoughtful adjustments to their past experiences to accommodate this difference.

Innovation processes are also likely to be more unpredictable than prior experiences. By having an end-to-end innovation process, "you start to find where you have bottlenecks within the organization," says Patrick Sullivan, chief architect of Chubb in the CIO organization. Sullivan likens innovation to building a road, with an identifiable end point but numerous places along the way where an organization can fail because execution is difficult.

Figure 3. Information technology support along the innovation life cycle
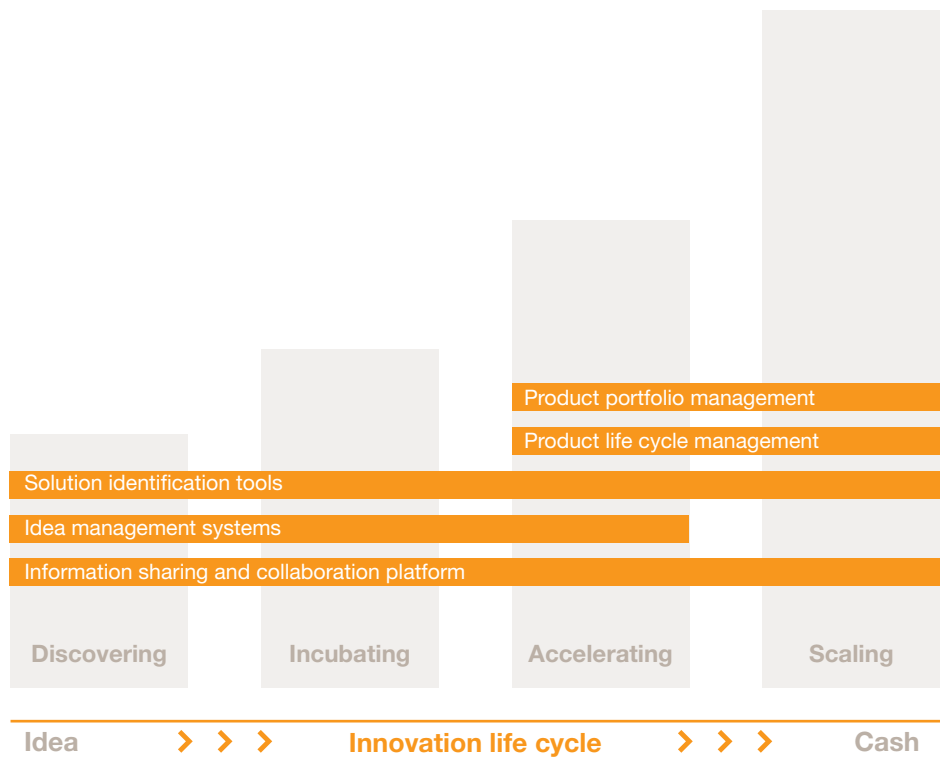

Product portfolio management

Product life cycle management

Solution identification tools

Idea management systems

Information sharing and collaboration platform

| Discovering | Incubating | Accelerating | Scaling |

Idea 〉〉〉 **Innovation life cycle** 〉〉〉 Cash

Technology-enabling the idea-to-cash innovation process

With an end-to-end innovation process defined and its management structure in place, the CIO's organization can do what it does best: implement tools that enable improved information flows and processes. A mapping of the tools along the innovation life cycle is shown in Figure 3.

Tools unique to the innovation process

Two types of tools, which the article, "Powering the innovation life cycle," on page 26 describes in detail, can be deployed to assist the innovation process.

Idea management tools. These tools facilitate idea creation through idea capture (the "idea funnel"), idea assessment (usually through collaborative communication and social networking components), and idea status tracking. They also provide the ability to translate high-level strategic challenges identified by the leadership team, as a result of assessment of ongoing operations, into demands on the enterprise for ideas that address specific problems and opportunities. (See Figure 4.) Often, enterprises hold challenges or competitions to generate ideas to address strategic challenges. The most sophisticated idea management systems track each stage from strategy through the idea-to-cash process.

An idea management system has made a difference at Chubb. "We've been able to much more rapidly discover new ideas and, in some cases, discover things that have been out there but were lost. You're able to build momentum around ideas through the transparency of the process, whereas in the old scheme, things kind of bounced around through the organization and never really got any traction," says Jon Bidwell, chief innovation officer of Chubb.

Idea capture and status tracking are the easy parts of such tools, whether they're homegrown wikis or commercial idea managers. The trickier part is idea assessment. Ideally, the assessment should be based on more than individual experience and opinions, and so having a way to access both internal knowledge repositories (such as marketing and R&D) and external knowledge repositories (such as market trends and component specifications) is ideal. In an automotive company, for example, the knowledge repository could include the details from its CAD/CAM/CAE and product information management systems.

These systems are further enhanced when the repositories are shared among trusted providers and vendors, as in a supply chain. In medical systems, for example, research, clinical trial, and patient results can be linked together in a "starter kit" knowledge repository for pharmaceutical companies, practitioners, hospitals, and insurers. The value is far greater when the data and insights are "crowdsourced" from qualified contributors.

Solution identification tools. Having ideas is important, but turning them into real products and services is the goal. Often, the solution to a problem is not a new idea but one that exists elsewhere and is waiting to be discovered and applied to the "foreign" context. That's where tools that use methodologies such as TRIZ[2] (also known as TIPS: Theory of Inventive Problem Solving) come in. These methodologies help the user derive the intrinsic patterns in the problem and find candidate solutions in repositories of patents, lab notes, reference material, Web sites, past problem-solving results, and nearly any source that has a problem and solution pattern. The step-change effect on innovation is here because most novel solutions—typically called inventions—are likely to come from other fields that address a conceptually similar pattern. These tools help identify a "foreign" solution that may be adaptable to the problem at hand.

2   According to Wikipedia, TRIZ is "a problem-solving, analysis and forecasting tool derived from the study of patterns of invention in the global patent literature." http://en.wikipedia.org/wiki/TRIZ

CIOs have the technology knowledge and the enabling platforms to give the innovation process the same advantages that technology brings to any enterprise process: consistency, efficiency, speed, deeper insight, and more predictable execution.

Another approach is to provide exploratory tools so staff can investigate issues to find an existing solution or identify a need for a solution. AES, an energy company, has developed a system it calls Revelation, which includes a rules-based engine that captures live plant-process information and historical data for pumps, motors, and other components. "One of the good things about the rules-based engine is that it enables plant engineers to really drive the behavior of the system going forward, because we are providing the platform and facilitating that," says Paul McCusker, CIO for the Europe, Middle East, and Asia region at AES. Although designed for operational analysis, Revelation is extensible as an innovation platform for ideation and solution identification. "We want this system to evolve to be our innovation platform that is global and allows more employees both from IT and non-IT functions to drive greater innovation at AES," he continues.

Most enterprises already use certain processes and software on portions of the innovation life cycle. Product life-cycle management (PLM) software is used in the acceleration and scaling phases after a product has been identified and investment has been sanctioned for its development. Project management systems are used when ideas become full-blown projects. And portfolio management systems manage a collection of projects or products. Matthew Greeley, CEO of Brightidea, explains that as ideas mature, an idea management system may hand off to these systems. "When you move into a project that is funded, then that project can either hand off to an existing portfolio management system or you can continue the project within our Pipeline product, which is a social project management application and is a lot like Facebook."

Innovation centers of excellence to facilitate adoption

In some cases, it makes sense for IT to set up groups to manage the idea management tools and knowledge management repositories, since these elements are crucial to executing the innovation process. Such groups should not become a repeat of the 1970s' "churches" in which business "supplicants" begged IT "high priests" for pearls of information wisdom. Instead, IT should be able to partner with users and apply their greater experience with such tools in a collaborative style. Doing so will reinforce the notion that IT is not "outside the business."

For example, the TRIZ methodology is complex and the supporting tools are designed for highly trained engineers, making it difficult to apply broadly. Thus, a TRIZ center of excellence within IT or the chief innovation officer's organization to support innovation efforts across the enterprise could be useful. This is not unlike centers of excellence for Six Sigma. "In Six Sigma, we teach people at the Green Belt, Black Belt, and Master Black Belt levels. We want everyone in the organization to have this Green Belt level of understanding, few to have Black Belt, and very few to have Master Black Belt. A similar concept can apply to structured problem solving," says Peter Hanik, president of Pretium Innovation.

The purpose of centers of excellence would be to understand the tool sets and to train and support others who use them. Accomplishing these goals requires staffing the team with people who are innovation advocates, who have the new technology skills, and who can help ensure the integration of the data and architectures of the new tools with the IT infrastructure.

Figure 5. CIOs can bootstrap the end-to-end process approach and systematic methods of problem solving within the IT function to facilitate adoption.

Bootstrap innovation life cycle within IT
• End-to-end process
• Problem-solving approaches

〉

IT as business unit consultants
on innovation process

〉

Enterprise-wide
innovation
management

● **IT innovation
management**

To facilitate adoption, many CIO organizations may consider the IT function to be a pilot for the end-to-end innovation life cycle. By bootstrapping the approach within IT and implementing the necessary idea management and solution identification tools, IT can gain valuable experience and insight necessary to transfer the same process to business. Next IT can become a consultant to business units and incrementally bring them into the end-to-end innovation process. Over time, this can evolve into an enterprise-wide innovation management platform. (See Figure 5.)

Test beds for use outside IT

The translation of many ideas into new products and services often requires synchronizing business functions, workflow, and information technology changes. "For us, nearly every road of innovation leads back to information technology," Bidwell says. Typically, in a business process reengineering effort, you test the new process in a pilot program; in a product development effort, you create prototypes. Likewise, an innovation process will benefit from having a way to test specific innovations being evaluated and developed where the new product or service relies on IT for its creation or delivery.

To the extent that IT can provision test beds for such innovations and streamline the information flows, the more effectively an organization can realize value from tests—or cut investments sooner when the innovation is not as promising or needs a different approach.

Although the test beds are often specific to the innovation being explored and must be custom built, in some cases IT can simplify and expedite the deployment of test beds to enable non-IT staff to explore innovation more easily. For example, virtualization tools let IT quickly spin up software development test beds, and this approach could be used to let innovators create test beds for Web-based products in a self-service way. IT also could set up test labs equipped with various emerging technologies, such as mobile devices, cloud-based services, and social networking tools that innovators could experiment with, aided by IT's expertise and maintenance.

Core systems may need to be strengthened and made more flexible

As an organization implements an innovation process and the tools to support it, it will likely find that the process and tools stress the core infrastructure. At the very least, IT will need to anticipate and enable a more modular application and information

architecture, one whose elements are more loosely coupled than legacy monolithic architectures.

One key aspect would be making information more broadly accessible in a secure manner. Perhaps the interface with customers or suppliers requires a new front end, such as a mobility interface or a social network presence. Regardless, the core information and IT systems will be the source and repository of all new information. In describing his team's experience of building an innovation platform at AES, McCusker shares, "In some sense, we have opened up the data to all employees regardless of stature or position. Lots of information—including commercial, safety, or operational data—that used to be locked away in paper records is now available for all to access, use, and build on." A big challenge in connecting the innovation platform to the operational platform and infrastructure is the expense and time it takes to make the changes. That's a problem regardless of any innovation process, but the inflexibility of the existing infrastructure may become more apparent as the organization tries to connect innovation to operations.

Some IT organizations have established a relatively flexible IT core that can serve as a platform for innovation. The concept of a flexible platform is not new; CIOs have pursued flexible, fast-change infrastructure and applications for decades. An approach that gained much discussion five years ago was the service-oriented architecture (SOA), which refactors IT assets into mix-and-match resources that can be combined and orchestrated as needed thanks to a design based on process abstraction and consistent interfaces.

"Many new ideas need a new way of using existing capabilities or of exposing them through different external channels or through newer processes that are internal. By conceptualizing IT capabilities as a set of services, we can put these capabilities onto the shelf, so to speak, and expose them for quick reuse, whether it's a reporting application for a BlackBerry or some form of a customer-facing application," says Sullivan.

IT can also enable the connections to enterprise information systems or, more precisely, to nonproduction copies of them, so any innovations that act on or add to the existing information systems can be tested in a real-world context. This would be useful, for example, for innovations involving customer self-service.

The real politick of the CIO's role in innovation

For a CIO to be effective in the two aspects of enabling an innovation process, he or she must first be a best-practices CIO whose infrastructure runs well and efficiently, meeting the organization's needs. Otherwise, the CIO won't be trusted to implement the enabling technology, much less be considered part of the innovation process's leadership team.

CIOs that aren't known for business process thinking will have a harder time becoming part of the leadership team, but if they're best-practice CIOs in their IT role, they could leverage the technology-enabling effort to demonstrate their process understanding as a respectful if uninvited contributor. Better is if the CIO has demonstrated process leadership within the IT organization, as that demonstrates successful process thinking even if in a different context.

A key difference between the innovation process and other processes CIOs have helped enable is that the innovation process crosses many more organizational boundaries than others—even the financial process. This is also why the innovation process is not likely to be owned by any one executive but, instead, by a team. CIOs are accustomed to partnering with team members, so this requirement should not be troublesome. "[Today, CIOs] must find champions in the world and within their organizations that will adopt them [technologies for innovation], so they're extremely well situated to be a driver of the innovation process and the adoption of these tools," says Brightidea's Greeley.

The team's formal and informal makeup depends on the nature of the organization and each individual business leader. Given the CIO's wide view of the organization's processes, he or she should be one of the principal team members, along with the CFO, chief innovation officer, R&D chief, and marketing chief. Where an organization has no chief innovation officer, the CIO might grow into that role, serving as the orchestrator of the innovation process redesign. (The R&D chief is typically focused on customer products and services, whereas the chief innovation officer's purview extends to innovating internal processes, so the CIO has a broader basis for which to fill a vacant chief innovation officer role.)

Conclusion

Innovation is unlike many previous process improvements because it is extremely strategic, thoughtful rather than transactional, and generally seen as unpredictable if not chaotic. But there is a process to enable it and to capture more value for the organization. The CIO's knowledge of the entire business at a process level and his or her methodical approach to systems and process design create a unique ability to help move innovation away from being an ad hoc, hit-or-miss activity. And the CIO has the technology knowledge and the enabling platforms to give the innovation process the same advantages that technology brings to any enterprise process: consistency, efficiency, speed, deeper insight, and more predictable execution.

As businesses look increasingly to revenue growth and ask the CIO to be more strategic, the CIO has the potential to do more than identify and add supporting technology for various initiatives. He or she can help design the end-to-end innovation process that leads to a better business in the first place, and then enable it as well.

If you're a CIO who wants out of a mere operations role, this is the chance you have been waiting for. In innovation, you could increase your strategic value and your business portfolio. One added benefit is that the CIO has a strong chance to demonstrate business acumen and leadership of business futures. This is precisely the ambition of CIOs, and most have the talent to do so. Now they have a great opportunity to turn that ambition into reality.

"In some sense, we have opened up the data to all employees regardless of stature or position. Lots of information—including commercial, safety, or operational data—that used to be locked away in paper records is now available for all to access, use, and build on."
—Paul McCusker of AES

Building an IT innovation platform

Paul McCusker of AES describes an example of innovation at AES and how that is seeding a platform for innovation.

Interview conducted by Vinod Baya and Bo Parker

PwC: Can you please tell us about AES and the role of IT there?

PM: AES is a global company, and our organization, AES Kilroot Power Station, has been part of AES since 1992. We produce a third of Northern Ireland's electricity, or about 600 megawatts generation. The power plant is a dual coal- and oil-fired plant just outside Belfast. We also participate in the all-island electricity market here.

From an IT perspective, we are narrowing the gap between IT and how IT is viewed by the business. We are aligning IT with the business strategy and how the business is changing. As the business gets larger, our senior leaders recognize that technology and innovation will play a much more important part in the business. We are starting that transformation from being a facilitator to being an enabler and then bringing innovation to the organization, so we can transform business practices and provide real tangible business value.

PwC: You have a particular innovation that has been successful at AES. Can you please tell us about your system?

PM: We have created a system called Revelation. The initial idea was to turn a paper-based log into an application that would interact with users, the plant, the plant historian system, and the operating environment. It is turning into a software suite to allow IT to address current and future challenges of an evolving multifarious business.

The software helps the business collect and process data efficiently, make better and more informed decisions, and reduce risk in key areas such as safety, environment, and compliance. This project evolved naturally and is a real example of an innovative approach. This isn't a project that came from the top down. It's a project that came from the bottom up, from employees experiencing business challenges and using their knowledge of emerging technologies to bring improvement on many fronts and deliver business value.

Right now, we have rolled out this project at our power plant. Given the success we are having, we fully expect this approach to become a platform for innovation, so that new and similar ideas at any of our 100-plus power plants across the globe can be brought to business value quickly.

Paul McCusker

Paul McCusker is the CIO for the AES Europe, Middle East, and Asia region. He joined the company in 2010 with the acquisition of Ballylumford power station in Northern Ireland, where he was the commercial director. Previously McCusker was CEO of a recruitment software company based in Dublin, Ireland.

Other participants in this interview from AES were Philip Moore and Ross Bradley.

In this interview, Paul McCusker describes how digitizing the safety near-miss reporting process using emerging technologies is allowing IT at AES to drive innovation globally.

PwC: What challenges were you were facing?

PM: We observed that there was scope to improve the reporting of safety and environmental incidents within the business. There was a manual process of collecting and scrutinizing data, and there were fundamental problems due to the lack of completeness and timeliness of that data being collected. Currently, most of the data is being collected by a paper-based method. That data then must be processed into various source systems, which is an arduous administrative task. We wanted to streamline the overall process.

Another challenge involved who had access and could use the data. We noticed that we had a vast amount of online monitored data that our PCS [Process Control System] was producing. But that data required daily analysis by engineers and skilled technicians to ensure that the plant was operating correctly. Also, information for operating the business, such as commercial, safety, environmental, and financial KPIs [key performance indicators] were unclear and inaccessible, as data was scattered around various subsystems. We wanted to make data more usable and accessible to a broader workforce. We also wanted to address potential problems before they happen and build the capability for ongoing, continuous improvement.

"As the business gets larger, our senior leaders recognize that technology and innovation will play a much more important part in the business."

PwC: Can you please tell us about the solution?

PM: Sure. We have digitized the process of reporting and logging plant safety near misses[1] and related incidents. We have done so by simplifying and lowering the barrier to logging information. Revelation will allow any person with a mobile device to report safety near misses, which could be safety incidents, accidents, or potential problem areas. Reporting happens from the site, during routine safety walks by managers or during any incidents or accidental events.

To create a new log, now all you do is enter the details of the issue as free text, similar to composing an e-mail, and attach a picture of the incident using the camera in the mobile device. This information will then be transmitted back to the server where other people can process the information or, depending on the severity, automatically alert others to a potential problem. No need to carry about multiple bits of paper and store them.

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1 A safety near miss is an unplanned event that did not result in injury or damage or any other threat to safety, but that had the potential to do so. Documentation and analysis of near misses improves an organization's environmental, health, and safety performance.

> *"We wanted to make data more usable and accessible to a broader workforce. We also wanted to address potential problems before they happen and build the capability for ongoing, continuous improvement."*

There are three key components to the system. Revelation mobile provides the mobile interface for logging. Revelation Web provides analysis and reporting via a Web interface. And a rules-based engine triggers alerts and work orders on the basis of the analysis and capture of live plant parts and process information. The system is also integrated to the SAP work order system, and rules have the ability to create SAP work order notifications through a secure Web service.

PwC: What benefit have you observed?

PM: The key benefit is reducing the risk of failure of any equipment by catching problems early and ultimately preventing the possibility of plant shutdown. For example, an employee has a handheld in his pocket. He passes a valve that is showing a symptom that could affect the availability of the generator. Instead of needing to remember to go back to the control room and log that as an issue, he can quickly open up the application on his handheld, take a picture, and log that incident straightaway. The information is recorded sooner and does not fall through the cracks.

The system improves our compliance with regulations. For example, one of the pieces of information that the system captures is the amount of oil that has been used by some of our equipment. The station uses various cooling systems to keep our assets operational. Typically, seawater is used as a cooling product. Leaks can occur in these cooling systems, and potentially the oil could discharge into the seawater, causing an unfavorable environmental impact.

By using Revelation and logging all the oil usage of the various tanks, we can now quickly determine how much oil is being used on-site. Using Revelation, we can quite quickly surface if we see an upward trend in oil usage and catch that before the problem manifests. Therefore, we reduce the risk of the plant going offline due to an environmental incident.

If something goes wrong, the earlier you spot it, the better. If something goes badly wrong, it can result in the plant needing to come offline. The commercial impact of that can be huge, not only in the loss of commercial availability for our customers, but also in penalties for us.

PwC: It seems like you have made information more broadly available to employees and improved their ability to act on it. What are your views on how much you open up access to information your systems are capturing?

PM: That's central to the success of the project. In some sense, we have opened up the data to all employees regardless of stature or position. Lots of information—including commercial, safety, or operational data—that used to be locked away in paper records is now available for all to access, use, and build on. Now anybody can view the information on the system. They have the full capability of seeing their information or others' information evolve from being logged to actually being closed off. We also have the ability to drive all those statistics and reports. So instead of management coming from the top down to say, "This is how we're performing," people can see for themselves and make their own decisions or develop their own views and then challenge management on ways that we can maybe make it better.

The feedback that we've received is very positive. With the people here—particularly people in the plant, who are not usually very accepting of change—we've been very surprised with the support and feedback that we've had from the multidisciplinary teams.

PwC: Where do you go from here? What is the future of your system?

PM: We want this system to evolve to be our innovation platform that is global and allows more employees both from IT and non-IT functions to drive greater innovation at AES. That's essentially what the system should be about. Already, we have had quite a few people from the business approach us with a sketch or the idea of a workflow and similar innovations, and we've managed to implement some of these.

One of the good things about the rules-based engine is that it enables plant engineers to really drive the behavior of the system going forward, because we are providing the platform and facilitating that. The system is successful only if people pick it up, use it, and that actually changes how they do their job. We expect in the future it should promote and encourage people to share their knowledge and innovative ideas.

"We want this system to evolve to be our innovation platform that is global and allows more employees both from IT and non-IT functions to drive greater innovation at AES."

To have a deeper conversation about how this subject may affect your business, please contact:

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Subtext

Innovation	Innovation is value-creating novelty, so a new product, process, or service that creates value for the business. Innovation can be incremental, substantial, or radical.
Idea to cash	The end-to-end process spanning the life cycle of an innovation, beginning with an idea and resulting in commercial impact on the enterprise.
Problem solving	Key activities all along the innovation life cycle that result in inventions that move the idea-to-cash process forward.
Idea management systems	Software to manage the discovery, incubation, acceleration, and scaling of ideas to create commercial value. They support a disciplined approach to managing the innovation life cycle and surfacing metrics to manage the flow and outcomes of the idea-to-cash process.
Solution identification systems	Software that helps systematize the invention activities of the innovation life cycle. They combine structured problem-solving methodologies (such as the TRIZ family of approaches) and semantic search and knowledge management techniques that support problem solving.