The IT Audit That Boosts Innovation

Innovators tend to think that information technology systems are too orderly and controlling even to cope with the messy process of innovation—much less enable it. But as some leading companies show, smart managers bring the whole IT menu to the challenge.

BY STEVEN R. GORDON AND MONIDEEPA TARAFDAR

THE LEADING QUESTION

How can organizations use information technology to increase the payoffs of their innovation investments?

FINDINGS

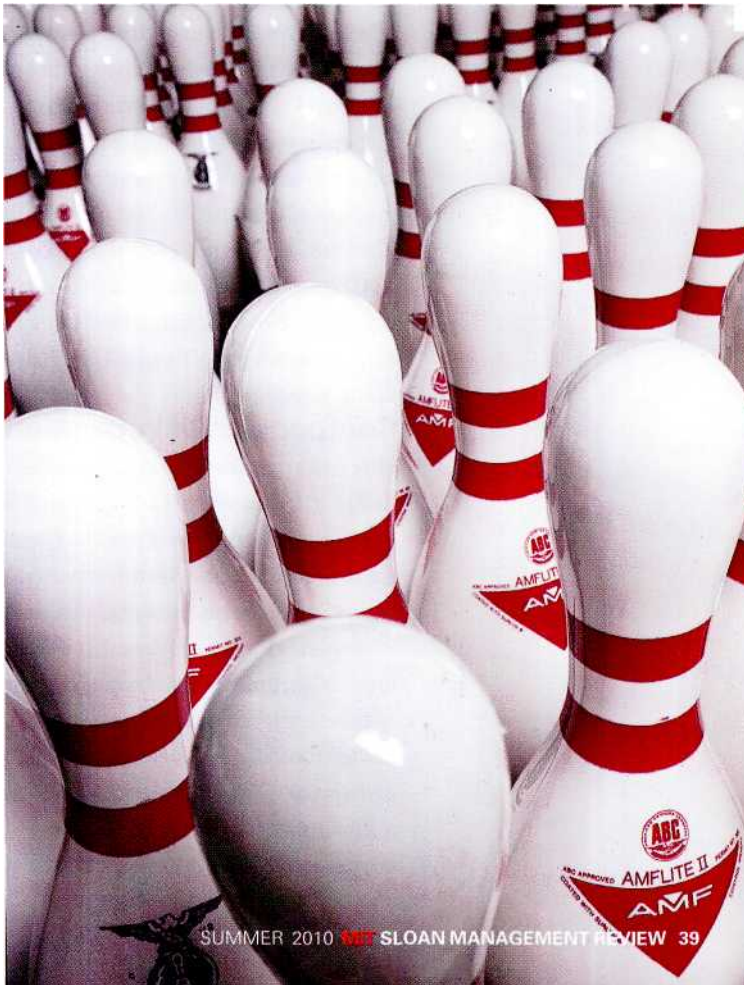
- IT departments should support innovators' activities by developing capabilities critical to the innovation process.
- IT can provide software tools that streamline the innovation process at all of its stages.
- Routines and policies are needed that give innovators adequate control over the IT resources they require.

ANY LARGE OR MIDSIZE COMPANY runs the risk of becoming stale and losing market share without tens, or more likely hundreds, of innovations under consideration and development at any given time. But with so many simultaneous projects, the company also needs to minimize duplication of effort, control the allocation of resources and ensure that it funds an appropriate mix of low-risk/incremental and high-risk/potential-breakthrough ideas.

For Unilever, the answer is Inoplan, a homegrown information system that aggregates and summarizes data from individual projects, providing a high level of control and review for upper-level management. For The Procter & Gamble Co., one solution is a web-based service called InnoCentive, which connects some 120,000 technical professionals from more than 175 countries.

Examples such as these are not rare, but they are not as common as one might suppose. Though scientists, designers, engineers and other innovators are used to working with computers to analyze their data and visualize their designs, the number one response to the question "How can IT help you?" tends to be some variation on "Keep it away!" That is, the IT department is generally seen as less of a help and more of a hindrance to innovation efforts.

The trouble is that information systems are traditionally designed to impose structure on processes, achieve predefined goals, produce metrics of progress and minimize the need for human interaction, while innovation activities are highly unstructured and emergent. They require tolerance for ambiguity and failure and the flexibility to redefine goals when opportunities or roadblocks arise. It is not surprising, then, that many innovators



Innovators at Dupont — the maker of the tough resin coating originally applied to bowling pins — can now easily store, retrieve and share information across the organization.

believe information systems will hamper their work and present barriers to their creativity and productivity. IT managers are no less frustrated. From their viewpoint, as a senior manager from E.I. du Pont de Nemours and Co. told us, one of the biggest issues is "IT getting a place at the [innovation-activity] table versus being a utility."

Yet the potential of information systems to improve the innovation process is too great to dismiss them out of hand. For example, visualization tools can help innovators make sense of data and uncover hidden relationships. Portfolio-management tools can help keep the innovation pipeline full, limit a company's financial exposure and fast-track the development of promising ideas. IT-enabled collaboration capabilities can bring together innovators with different skills to solve multidisciplinary problems. And IT-based knowledge management can help innovators find information they need from vast pools of organizational knowledge resources.

We undertook research to learn how some leading innovators have used information systems to make their innovation activities more effective and efficient. We examined the ways in which they improved the innovation process through better use of IT and through effective partnership with the IT department, thus accelerating the conversion of research and development into business growth and increasing the yield of the innovation portfolio. (See "About the Research.")

The research results that follow essentially provide a checklist by which enlightened innovation managers may review how IT can bolster their efforts.

Components of Innovation Success

Our research shows that companies require three things in order to use IT for facilitating innovation activities. First, they need specific IT-enabled organizational *capabilities*, which are formed by combining their IT assets (data, infrastructure and expertise, for example) with non-IT assets (such as creativity of innovators, technological sophistication of top management and laboratory resources) to enable the across-the-board processes essential to developing and applying innovations.[1] Second, companies need a strong set of IT-based *tools* to effectively sustain the central activities required for innovation and to support the analytical work that scientists, engineers and designers need to transform ideas into products, processes and services. Third, companies need a system of *control* that allows innovation workers to access and use the IT resources effectively.

Capabilities, tools and control are the three legs of the innovation stool. Excellence in any two of the areas is insufficient. If the third is lacking, excellence in innovation will be difficult if not impossible to achieve.

I. Capabilities We identify six organizational capabilities typical of companies that effectively use information systems to boost their innovation performance: (1) portfolio and project management; (2) collaboration; (3) knowledge and information management; (4) business-IT linkage; (5) ambidexterity; and (6) competitive intelligence.

1. Portfolio and Project Management. This capability is required to organize and administer the company's portfolio of innovation activities. Lacking it, the company may not know when to terminate projects that are in trouble or may underfund those needing to clear a threshold. The company also will not be able to aim toward optimality in the size of its portfolio. On the one hand, having too few innovations under development exposes a company to the risk of being unable to improve its products and services sufficiently to fuel growth or even sustain market share. On the other hand, supporting too many innovation projects runs the risk that the company will be unable to marshal the resources necessary for proper and timely development of its innovations. Therefore, this capability draws on portfolio-management tools to help managers maintain a viable pipeline of innovation projects at various stages and funding levels. And it draws on project-management software to allocate resources within projects, set deadlines and monitor progress.

Many of the companies we surveyed or researched had developed their own portfolio/project-management systems. At Dow AgroSciences LLC, a leader in biotechnology products, this capability is manifested in a process, called "Create Product Success," that has been in place since 1998. The process takes an innovation project through five key documents: business case, technological and commercial assumptions,

marketing plan, milestones and a benchmarking of customer needs against competitors' products. An information system supports this process, allowing for distributed data preparation and entry, consolidation of information and summarization at the appropriate levels for decision making. As project-level information filters through the business, regional managers and "molecule" managers make recommendations regarding the continuation of ongoing projects and the funding of new ones. A Portfolio Management Forum — consisting of global business leaders for each line of business, individual business leaders for each molecule and pertinent biotechnology experts — then follows up on the recommendations.[2]

2. Collaboration. This capability allows innovators with the requisite knowledge and expertise to connect with one another synchronously or asynchronously, across large distances and multiple time zones, regardless of whether they are employees of the company involved. Importantly, this capability enables participants to stimulate one another's creative efforts by sharing knowledge, information and ideas. It relies on communication tools such as networks, e-mail, virtual meetings, webcams, instant messaging and blogs, and on more relation-oriented tools such as file-synchronization software, multiuser editors, blogs, wikis, tagging and social networking.

IBM Corp. has demonstrated this capability with its Innovation Jams — online brainstorming sessions where participants interact and collaborate to generate ideas — which the company has been running since 2001. The 2006 session involved approximately 150,000 IBM employees, business partners, clients and university researchers in 104 countries over two three-day phases. The payoff: IBM invested $100 million in 10 new businesses that evolved from ideas generated during that session.[3]

The Boeing Co. provides another example of successful collaboration. Boeing developed and deployed its Boeing 777 aircraft in record time because of its ability to manage the collaboration of some 240 design/build teams. By sharing and coordinating information, these teams were able to proceed with their respective subprojects concurrently.[4]

3. Knowledge and Information Management. The innovation process, by its very nature, is knowledge intensive. Innovators might start with an idea and a personal base of knowledge, but to transform the idea into a new product, service or process, they typically need to access the knowledge of others and integrate it with their own. History clearly shows that individuals and companies generate more innovations — and innovations of higher value — when they draw from a conceptually and geographically diverse pool of knowledge. Thus the capability of knowledge and information management is crucial for connecting these isolated "pockets of innovation." This capability can be enhanced by expert systems, data mining software (for knowledge creation and abstraction), database systems (for storage and retrieval), portals (for knowledge dissemination), decision support systems (for knowledge application) and knowledge repositories (for locating needed types of expertise).

4. Business-IT Linkage. The objective of this capability is to make IT departments more like partners with innovation centers, thereby fostering productive interactions between them. Toward that end, it is important that innovators have a basic knowledge of IT and that IT professionals appreciate the elements of innovation. Without a business-IT linkage capability, innovators would likely be reluctant to ask the IT department for assistance because they would expect IT specialists to lack creativity and favor standardization. The result of such stereotyping is that the innovators

ABOUT THE RESEARCH

The authors used a variety of techniques to collect data for this study. Initially, we administered a questionnaire to members of the Industrial Research Institute (IRI), a trade organization of research and development executives, and to members of the Babson College Innovation & Corporate Entrepreneurship Research Center. The questions aimed to identify the IT tools that these companies have used for innovation activities, their degrees of success with the tools and how the companies' IT departments have contributed to the success of innovation. We also ran a nominal group technique exercise with 70 members of the IRI to brainstorm on how IT can best contribute to company innovation projects.

Simultaneously, we hosted a series of six three-hour focus groups with self-selected members of the IRI to seek their perspective on this issue and their input on the parameters of our study. Attended by some 53 individuals from 36 organizations — ranging from global multi-industry companies such as E.I. du Pont de Nemours and Co. to industry leaders (e.g., The Boeing Co.) to government entities such as the U.S. National Aeronautics and Space Administration — the focus groups provided especially rich data on the diversity among organizations in their IT capability and its role in innovation.

Finally, we used a multisite case study approach at 12 companies, some in the service industries, to explore in greater depth some of the compelling examples that were discussed in the focus groups.

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could miss learning about IT-based tools that might help them better execute their projects and realize their goals.

One way to develop this capability is to hold periodic conferences and focus groups at which IT specialists and researchers share their expertise. Another way is to require IT specialists to sit in on important R&D meetings to help them gain a better understanding of innovation processes and to facilitate team building. Yet another way is to hold IT specialists responsible for innovation-success metrics such as ease of collaboration and effectiveness of accessible knowledge. An innovator from Archer Daniels Midland Co. told us, "Things like simulation are half IT, half R&D. We have encouraged IT to understand more of what we do and come up with their own ideas regarding what R&D can use." At one of the other companies we studied, the VP of innovation had dotted-line reporting from the CIO.

5. Ambidexterity. This capability of the IT staff allows it to achieve excellence in operations while maintaining a clear strategic vision, balancing the attention to each as warranted by the environment.

If the IT function lacks operational excellence, the quality of its support will be inferior. Its networks, servers, databases, intranets and portals — components that form the infrastructural and support backbone for companywide knowledge management and collaboration systems—will lack adequate functionality. Collaboration technologies such as wikis and social networking will also be compromised, or unavailable.

However, if the IT function lacks strategic vision, it could be driven by standardization zeal and fail to appreciate the need for acquiring and supporting the kinds of nonstandard applications and processes often required by innovators. Further, IT could be unwilling to explore ways to facilitate innovation. One company we studied demonstrated strategic vision by granting resources to IT for innovation activities based on the need to stay at the cutting edge rather than on detailed ROI/cost/standardization criteria.

6. Competitive Intelligence. This capability facilitates learning what competitors are doing, what they are failing to do and thus where innovation opportunities might lie. For example, in recent years companies have found that blogs and wikis are effective for publishing and circulating information about their own and competitors' products and services. But while responses to a blog posting often result in a long and hard-to-read trail of opinions and counter-opinions, a wiki page on a given subject will appear as a well-conceived and organized article. Through frequent editing, wiki pages converge into a coherent presentation, where alternative views can be presented with their pros and cons. Companies are also monitoring social networking sites to learn how customers are responding to their products and competitors' products. For such online competitive intelligence tobeuser- friendly and productive, a solid working relationship between IT staff and innovators is essential.

II. Tools Innovators who routinely make effective use of IT employ a robust set of tools that are easy to learn and that address users' specific technical needs. By contrast, tools that have long learning curves relative to the frequency or length of tool usage are less likely to "stick."

One way to increase the stickiness, or sustainability, of tools is to let the R&D department choose its own, based on the tools' perceived value. Another approach, which has been adopted at The Clorox Co. and elsewhere, is for R&D to work jointly with the IT department to identify, acquire and implement specific tools. As an innovator from Corning Inc. told us, "letting the users drive the design of the tools," even though they are developed by IT, leads to tools that stick. This approach ensures alignment with R&D needs and tool characteristics, leading to better and more sustainable solutions. In fact, the approach often creates R&D "superusers" who become expert in the use of the tool and can be resources for deploying and training, which further increases its stickiness.

Conversely, as one of our study participants said, "IT should not dictate" what tools should and should not be used. When IT departments select the tools, innovators may not understand their value or may simply find the tools unsuited to their needs. It is wishful thinking that IT specialists can use their expertise in software to purchase a toolbox containing a relevant and appropriate set of

innovation tools for their company. Innovators need to work with their IT departments to identify or develop the tools that they need to do their jobs.

Meanwhile, to address concerns about intellectual property, corporate leaders responsible for the procurement, development and maintenance of tools (innovation managers or corporate IT) need to offer guidance to innovators. They must provide clarity about steps that need to be taken and processes to put in place to prevent data loss or intrusion.

For each type of tool, products from many vendors exist, and they may differ from one another subtly, yet in ways that are significant for those who obtain the most value from them. (See "IT Tools to Support and Manage Innovation," p. 44.)

III. Control One of the most important roadblocks to innovation occurs when R&D staff lack adequate control — of the computing resources and tools they require—owing, for example, to rigid standardization policies. An absence of innovation-facilitating IT governance practices is often at the root of the problem.

We observed many different models of control. Some organizations put significant IT resources directly in the hands of the R&D department; others provide for shared control of resources with the IT department; and still others assign control to a third party. The specific mode of control is not as important as its capability to facilitate routines and policies for addressing innovators' requirements.

IT departments have good reasons for wanting to control hardware and software. The standards they set can smooth the flow of intraorganizational data, reduce hardware and software redundancy and lower costs. But innovators sometimes wish to acquire nonstandard or "one-off" tools for specialized tasks, even as they would ideally like such tools to be supported by the IT department. Neither may be possible if these tools are not compatible with existing standards.

Our study showed, however, that letting standardization be the driving IT philosophy is not effective when it comes to innovation tools. Asking innovators to create a "business plan" to explain

IT TOOLS TO SUPPORT AND MANAGE INNOVATION

Innovators use a broad variety of IT tools, which vary in sophistication, capability and price. In most cases, organizations operating on tight budgets can make use of open-source versions to keep costs low. The placement of examples shown is illustrative; many products provide support outside the row in which they appear.

CLASS	TYPE	DESCRIPTION	EXAMPLES
Idea Generation	Brainstorming/ Mind-mapping	Help generate ideas, diagnose problems, collect and track ideas	•Mindjet MindManager •ConceptDraw MINDMAP •Brightidea WebStorm
	Market Research/ Competitive Intelligence/ Strategic Problem Solving	Understand problems with existing products, uncover opportunities	•Imaginatik Idea Central •Invention Machine Goldfire •OVO Tools •Sopheon Vision Strategist
Analysis	Simulation Modeling	General modeling tools aligned with a discipline — e.g., chemical reactions or stress analysis	•Excel •ProModel •Industry-specific tools
	Statistical	Assess strength of relationships in experiments	•SPSS •SAS
	Process Management	Simulate and assess process-design alternatives	•Lombardi •Metastorm •BPM
	Visualization/Design	Perform visual analysis	•Autodesk AutoCAD •Google SketchUp •Molecular visualization
	Rapid Prototyping	Create prototype directly from design tool	•Autodesk Inventor •Objet
Collaboration	Social Networking	Connect with innovators, marketers and others both inside and outside the company	•IBM Lotus Connections •PHPizabi •Relenet •Facebook, LinkedIn, Twitter, Delicious •Linked expert blogs on specialized subjects
	Document Management/ Portal	Facilitate sharing of documents and knowledge	•Microsoft SharePoint •IBM WebSphere •Open Text, Livelink •Atlassian Confluence
	Communication	Enable video conferencing, messaging	•Skype, VideoLink •Microsoft Messenger, AIM •Twitter
Innovation Management	Portfolio Management	Track project status, analyze pipeline, assess risk/ reward alternatives	•CA Clarity •Oracle Primavera
	Project Management	Plan and sequence tasks, commit resources, monitor deadlines	•Microsoft Project •Open Source Project.net
	Product Life Cycle Management	Manage product life cycle through conception, design, manufacture, service and disposal	•Siemens •Oracle/Agile •SAP PLM
	Intellectual Property Management	Enable patent search, patent management, docketing, business intelligence, partner and open innovation	•RSGMedia RightsLogic •Anaqua

and justify nonstandard-tool expenditures is also not a good idea; the effort can be time-consuming, counterproductive, unnecessary and an impediment to acquiring the tools in question. In such cases, R&D departments can be well served if they are allowed to control their own IT tools, especially those that are specialized and unique. Archer Daniels Midland, for example, has a well-staffed IT group within R&D.

Another approach is for R&D and corporate IT to work out variance policies for permitting deviations from standardization when appropriate and for supporting the tools involved. At DuPont, for example, an IT manager is responsible for evaluating R&D tool requests that require variances from the corporate standard and for presenting them to the IT department for approval. The manager is careful, however, not to tread on the R&D department's culture. Similarly, at Illinois Tool Works Inc., any IT liaison to R&D would "have to listen very hard first" before making any suggestions. Also, R&D departments allow for more failure and greater slack, so cost — often the primary criterion used by the IT department in its selection of products — is not necessarily a good criterion for R&D tool selection.

Lessons for R&D Managers and Innovation Leaders

Building an organization's capabilities for innovation implies not only the acquisition of technologies but also the recognition that the IT department has an important role to play. It can contribute significantly to identifying the technologies appropriate for a specific company and project, to applying them to the innovation process and to maintaining the necessary capabilities. Thus the primary lesson for innovators is that IT can and should be an active partner in innovation, not an enemy. All too often, however, the IT department is not even at the table when its ideas and support would be most valuable.

Establishing a working relationship between R&D and IT is not always easy, especially because researchers typically have little time to spare in creating and nurturing it. One solution is to invite IT specialists to attend, and possibly present, at R&D conferences and brainstorming events that are already on innovators' schedules. There might well be beneficial outcomes. For example, at one such event at DuPont, a staff member from IT presented a game engine he had developed to help produce atomic-force microscopic images. A fabrics researcher attending the event recognized that the software, with modest adaptation, could help him understand and solve problems in his own field.

This serendipitous result actually reflects a large and chronic problem — insufficient appreciation by R&D professionals of what IT may have to offer. Innovators often fail to use the tools that are already in-house because they (1) underestimate the tools' value and forgo their adoption, (2) find them difficult to use or (3) fear the threat of intellectual property leakage. R&D managers need to address all three objections, which are discussed below.

To facilitate adoption of a promising tool that was "not invented here," research leaders should set a strong example by adopting the tool for their own work and encouraging others to follow suit — not for superficial reasons but because of the benefits that could accrue to individual researchers and the organization as a whole. One manager told us that at first he had to urge people to use the wiki developed by another department. "It was seen as another form of tax," he said, and therefore adopted at the lowest possible levels and often with reluctance. But once "people actually started using it internally as a way for them ... to track their own progress — to be able to say'here is what I've done' and be able to tell a story" that benefited their projects — its use blossomed.

R&D leaders can address the difficulty of tool use by working with IT to simplify the interfaces and add features that offer the user some help. At Corning, for example, scientists and research managers have been heavily involved in the formation of such an IT toolset to support the company's Revitalizing Innovation Globally initiative. R&D management can also employ a"technologyfacilitator"whose role is to become an expert in and standing resource for some of the more complex or infrequently used tools.

The heightened usage of tools, however, can increase the visibility and availability of innovation-related information, which is often sensitive and intellectual property related as well. Because R&D staff might perceive the tools' levels of data security and privacy to be inadequate, innovation leaders need to work closely with their IT counterparts to create appropriate

safeguards for every information repository that might hold intellectual property. Both sides must understand the risks of corporate espionage and strengthen their tools against it.

Finally, R&D managers may need to educate the IT department about the technologies underlying the innovations under consideration and about the innovation process itself. By being drawn into the process, IT gains the potential to help lead in the development of innovation capabilities rather than simply react to the day-to-day needs of the research community.

Lessons for IT Managers

We have identified four roles that IT departments should assume in the innovation process — benchmarker, integrator, educator and enabler.

As a *benchmarker,* the IT department can sort through the plethora of tools available to identify those that have been successfully used in similar environments. The success of knowledge management, collaboration and competitive intelligence in particular depends on using the right technologies for the given organizational setting. One of our participants said that the "IT department n«eds to inform users about best practices in these areas — and tell us what the industry is doing."

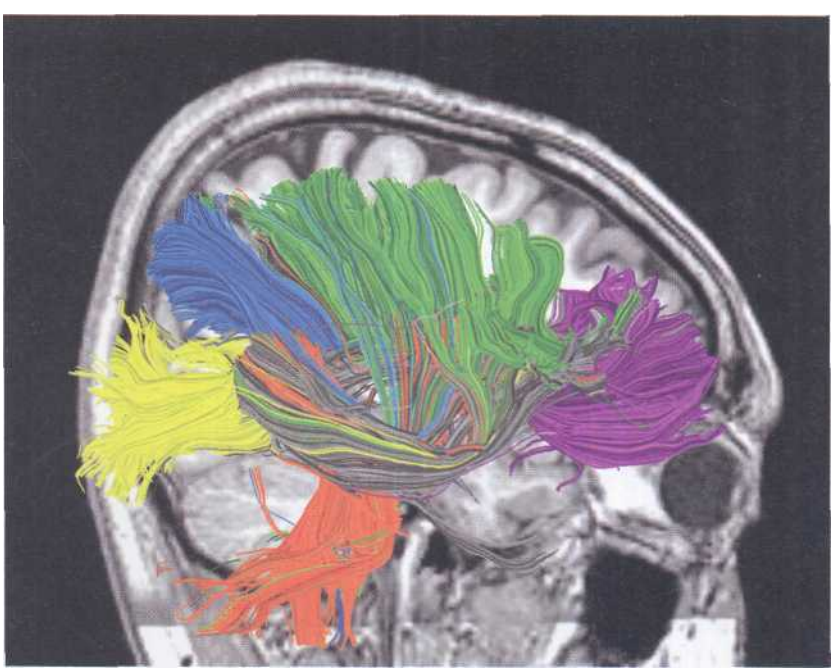
As an *integrator,* and consistent with its position as keeper and analyzer of knowledge, IT should identify opportunities to dissolve information silos, integrate knowledge systems and instigate collaborations. At DuPont, for instance, innovators at central R&D were initially using segregated external online sources for knowledge dissemination, but they ran into problems of integration and consolidation across customers (other DuPont divisions). Adopting a different approach, the innovators worked with IT to develop and deploy a homegrown knowledge-management system through a consolidated portal.

There were two major outcomes: Customers could easily identify and retrieve relevant information, and the portal could be expanded and updated to include more functions and information domains. As a result, many applications that had hitherto been disparate were folded into the portal, so that the process of storing and retrieving knowledge became more efficient and effective. The cycle time for searching and providing information fell virtually to zero. The same approach was applied to another case, in which different innovation teams were initially using disparate collaboration tools. The tools were folded into one collaboration mechanism, leading to a "federated" system that scientists across areas could use.

In a similar manner, innovators at Corning have been moving toward a central repository of information that synthesizes ideas about cutting-edge practices in the company's diverse fields of research and communities of practice. Such advances require not only technology-integration skills on the part of IT but also a bird's-eye view of the organization's full range of innovation activities.

As an *educator,* the IT department can extol the virtues of structured process-management practices such as Six Sigma and House of Quality. When an innovation project enters the later stages of development and implementation, and an increasing number of physically dispersed innovators are involved, the application of structured project-managementpractices improves the project's efficiency and throughput. Three companies in our study — DuPont, Corning and Mercy Health Partners — have incorporated such practices, which were conceived primarily by the IT department and implemented jointly by IT and the innovators. The logic in doing so was to achieve an "ability to work with the lack of structure inherent in innovation while simultaneously imposing a more rigorous and linear structure on the

IBM's "Innovation Jams" involve employees, clients, partners, and researchers in generating ideas, some of which lead to collaborations like one between IBM scientists and universities devoted to understanding the complex wiring of the brain.



innovation process," as one participant put it.

Direct involvement of IT specialists in project teams ensures awareness of innovators' needs on the part of IT and greater leverage in the use of formal project-management methodologies and practices. IT specialists can therefore work on "pull" rather than "push" modes and fruitfully participate in project decisions, thereby speeding up experimentation, collaboration, prototyping and documentation.

As an *enabler*, the IT department should provide and support tools required by the innovators, and it should be directly involved in developing new tools as the need arises. We found, however, that IT departments often fail to assume this role. Apart from what it ought to do, what the IT department should avoid doing is mandating standardization, which acts to prevent a "bottom up" emergence of IT tools inspired by the innovators. As one DuPont participant noted, "It is important for IT people to position themselves as credible research partners — to create the sense that their work can bring value to the research."

Lessons for CEOs

Because innovation capabilities reflect the overall organization, the CEO is ultimately responsible for ensuring their continuous development. This company leader may delegate that responsibility to some extent, but ultimately he or she must keep a firm hand on the tiller. In doing so, the CEO can:

- Actively participate in deciding what innovation initiatives are funded and ensure that the appropriate controls and information are in place for making those decisions.
- Recognize and reward collaborative work, insist on cross-functional and cross-disciplinary projects and support funding for the technological infrastructures that enable collaborative activities.
- Play a key role in creating the business-IT linkage capability by appointing to the IT leadership position someone who has a strong knowledge of company processes, goals and strategy and who is trusted by other business leaders — as opposed to someone whose primary attribute is experience with technology.
- Enhance this capability by ensuring that IT leadership has a role in the executive "cabinet" and is consulted on key decisions.
- Encourage ambidexterity in the IT department by insisting on strong operational performance goals in conjunction with a compelling R&D-focused strategic vision.
- Help ensure that innovators have adequate control over the computing resources that they need to be most efficient. Although issues of control play out between departments, the CEO is the ultimate arbitrator of these governance conflicts.
- Recognize that innovation is not simply a matter of R&D but a socially complex process engaging other corporate functions such as manufacturing, legal, marketing and sales. Because information systems are critical to coordinating and increasing the effectiveness of these functions' interactions, they are also critical to facilitating the innovation process.

When R&D managers, innovation leaders, IT managers and senior leadership all understand the role that information technology can play in streamlining and accelerating the innovation process, a company will be well on its way toward producing more innovations, and better innovations, with the resources at its disposal.

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