The Age of Hyperspecialization

The work of the future will be atomized, with many workers doing pieces of what is today a single job. Here’s what that means for your company—and you. by Thomas W. Malone, Robert J. Laubacher, and Tammy Johns
TopCoder is the world's largest competitive software development Community and Platform with more than 300,000 developers and digital creatives representing over 200 countries and hosts the largest and most comprehensive developer ratings and performance metrics available. The TopCoder Community builds software and community platforms for a wide-ranging client base through a competitive, rigorous, standards based methodology.

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ADAM SMITH’S WEALTH OF NATIONS, published in 1776, famously described what would be one of the central drivers of economic progress for centuries to come: the division of labor.

Much of the prosperity our world now enjoys comes from the productivity gains of dividing work into ever smaller tasks performed by ever more specialized workers. Today, thanks to the rise of knowledge work and communications technology, this subdivision of labor has advanced to a point where the next difference in degree will constitute a difference in kind. We are entering an era of hyperspecialization—a very different, and not yet widely understood, world of work.

Looking at today’s terrifically complex supply chains, one might think we’ve already reached the extremes of specialization. Boeing’s initiative to build the 787 Dreamliner, for example, was hailed as the epitome of subcontracting—and then proved to have gone a bridge too far when the parts failed to come together as seamlessly as envisioned, and delays ensued. A web page listing just the “major” suppliers of the plane’s components contains 379 links. But an aircraft is fundamentally a physical product. Consider how much more finely work can be diced when it produces intangible, knowledge-based goods and the information involved can be transported anywhere in the world nearly instantaneously and at almost no cost.

Just as people in the early days of industrialization saw single jobs (such as a pin maker’s) transformed into many jobs (Adam Smith observed 18 separate steps in a pin factory), we will now see knowledge-worker jobs—salesperson, secretary, engineer—atomize into complex networks of people all over the world performing highly specialized tasks. Even job titles of recent vintage will soon strike us as quaint. “Software developer,” for example, already obscures the reality that often in a software project, different specialists are responsible for design, coding, and testing. And that is the simplest scenario. When TopCoder, a start-up software firm based in Connecticut, gets involved, the same software may be touched by dozens of contributors.

TopCoder chops its clients’ IT projects into bite-size chunks and offers them up to its worldwide community of freelance developers as competitive challenges (opening the possibility of becoming a “top coder”). For instance, a project might begin with a contest to generate the best new software-product idea. A second contest might provide a high-level description of the project’s goals and challenge developers to create the document that best translates them into detailed system requirements. (TopCoder hosts a web forum that allows developers to query the client for more details, and all those questions and answers become visible to all competitors.) The winning specifications document might become the basis for the next contest, in which other developers compete to design the system’s architecture, specifying the required pieces of software and the connections among them. Further contests are launched to develop each of the pieces separately and then to integrate them into a working whole. Finally, still other programmers compete to find and correct bugs in the sundry parts of the system.

TopCoder’s model is intriguing, not least for what it allows its network of almost 300,000 developers from more than 200 countries to do. Because the company aggregates demand for specific tasks, it enables a developer who is particularly good at, say, designing user interfaces to spend the bulk of his or her time doing just that. Indeed, TopCoder developers are becoming increasingly specialized. Some focus on programming specific kinds of software such as small graphics modules. Some have discovered a talent for putting together software components that others have written. And some specialize in fixing bugs in other people’s code.

In the great tradition of the division of labor, this hyperspecialization pays off. TopCoder can often provide its clients with development work that is comparable in quality to what they would get by more traditional means but at as little as 25% of the cost. And it manages to do this while maintaining a satisfied, well-paid community of coders. As we’ll discuss, the potential quality, speed, and cost advantages virtually guarantee that this model will become
As labor becomes more knowledge based and communications technology advances, the division of labor accelerates. The hyperspecialization of workers may be inevitable given the quality, speed, and cost advantages it offers employers—and the power it gives individuals to devote flexible hours to tasks of their choice.

This will force managers to master a new set of skills: dividing work into assignable micro tasks; attracting specialized workers to perform them; ensuring acceptable quality; and integrating many pieces into whole solutions. Firms will learn to rely on a new breed of intermediaries—from small assignment brokers like Amazon’s Mechanical Turk to complex problem posers like InnoCentive.

Hyperspecialization also creates new social challenges, such as the possibility of exploitation as work quickly finds the cheapest takers, and the opportunity for deception when workers can’t see the larger purposes to which they are contributing. New global standards or regulations may be required, while guildlike organizations may address workers’ needs for continuing skill development and a sense of community.

More widespread. But will its benefits be unalloyed? To ensure that hyperspecialization is as welcome as it is likely, we must keep our eyes open to its possible dangers.

Fast, Cheap, and Under Control

The term “hyperspecialization” is not synonymous with outsourcing work to other companies or distributing it to other places (as in offshoring), although it is facilitated by the same technologies. Rather, it means breaking work previously done by one person into more-specialized pieces done by several people. Whether or not those pieces are outsourced or distributed, their separation often leads to improvements in quality, speed, and cost.

To understand the magnitude of the quality gains that hyperspecialization makes possible, consider how much time you personally spend on tasks that don’t draw on your expertise and that you may not even be particularly adept at performing. Just like craft workers of the past, knowledge workers engage in myriad peripheral activities that could be done better or more cheaply by others (particularly others who specialize in them). Project managers, for example, spend untold hours preparing slide decks even though few of them have the software facility and design sensibilities to do that well. Some are able to delegate the task, which at least allows it to be accomplished less expensively. But imagine a service like TopCoder that could offer instant access to a network of PowerPoint jockeys. Imagine further that some of those remote workers were brilliant chart producers, others were eagle-eyed proofreaders, and still others were content experts for different types of presentations. (Some, for instance, might specialize in sales presentations for office supply products, and others in internal project review meetings for the pharmaceutical industry.) Add an inspired graphic designer, and there’s little doubt that the presentation would be enhanced.

Quality improves when more of the work that goes into a final product is done by people who are good at it. The improvement is even greater when, as with TopCoder projects, people who are good at work compete with one another to get it. This is the power of the online “open innovation marketplace” InnoCentive, which connects seekers of solutions—mainly businesses facing science and technology challenges—with solvers who may have fresh answers. (Full disclosure: Thomas W. Malone is a member of InnoCentive’s advisory board.) On any given day, thousands of scientists, engineers, students, and others troll through InnoCentive’s website looking for challenges that intrigue them. They know that if they formulate the solution that works best, they stand to collect the posted reward—which in some cases exceeds $100,000.

For seekers, the appeal of InnoCentive lies mainly in the quality of the solutions it can yield. By casting the net so widely, it often pulls in solvers with very specialized experience who can make headway on problems that have stumped internal experts. For
instance, as the business writers Julian Birkinshaw and Stuart Crainer have described, the pharmaceutical company Roche wanted to find a better way of measuring the volume and quality of clinical specimens passing through its automated chemistry analyzers. In 2008 it sponsored a contest on InnoCentive. After two months it had received 113 proposals from solvers around the world. Tod Bedilion, then the director of technology management for Roche Diagnostics, was amazed to find among them a novel solution that had eluded Roche for 15 years.

That example speaks to another major benefit of hyperspecialization: speed. In Roche’s case, the isolation of the problem and the competition around it dramatically accelerated the discovery of a solution. More generally, hyperspecialization can reduce clock time by assigning related tasks to different people who then accomplish them in parallel rather than serially. This can be as simple as many hands making fast work. A company called CastingWords, for example, produces transcriptions of audio files with incredible speed—sometimes in less time than the recording itself took to make. How is this possible? It’s not rocket science: CastingWords simply breaks the audio file into many chunks and has remote workers, whose services it procures through Amazon’s Mechanical Turk site, transcribe them simultaneously. Its automated processes use overlaps in the assigned bits to catch errors (by comparing different transcribers’ renditions of the same phrase), and knit the separate pieces of text into a final product. Its quality-checking also reveals which workers can be trusted to do well on future assignments. “CastingWords seems like a magic trick to me,” a user named Merlin Mann comments on its site. “I babble for an hour, upload an MP3, and, somehow, they turn that into paragraphs. In, like, a day. It’s nuts. Like making a lady disappear.”

This ability to distribute computer-based jobs to a vast army of workers doesn’t only make old tasks go faster; it enables the completion of a whole new class of time-critical tasks. Consider the search for Jim Gray, a well-known computer scientist who disappeared at sea in his small sailboat in 2007 and was never found. When the news of his disappearance reached his colleagues, they realized it would not be impossible to search the 30,000-square-mile patch of ocean in which Gray’s boat just might still be afloat. Over the next few days near-real-time satellite images were relayed to thousands of Mechanical Turk workers and volunteers for close examination. Such an effort could not previously have been imagined—and suggests many other possibilities, from scanning for suspicious activity in an office building’s overnight video feeds, to translating headquarters communications simultaneously into many languages, to responding quickly to a potential client’s complicated request for proposal.

Increased speed is one of the reasons that hyperspecialization can reduce costs. Bedilion had this to say about his InnoCentive experience: “I couldn’t put 10 people in a room and have a brainstorming session or a two-day seminar for the same cost with all the travel involved. And I would have gotten a few hundred sticky notes rather than an entire notebook with 113 separate detailed proposals.”

The biggest cost saving for most companies may come in the form of better utilization of their own employees’ time. Because hyperspecialization entails off-loading the pieces of knowledge workers’ jobs that can be done more efficiently by remote specialists, those knowledge workers immediately have time freed up to spend on the higher-value tasks that only they can do. For example, in any business-to-business sales process, accurate contact information about prospects must be assembled. As essential as that activity is, it’s a terrible misuse of the time of an effective sales representative. How much better to employ microspecialists—such as the workers recruited by Samasource, a nonprofit based in San Francisco. Samasource sends this kind of data-entry work to individuals in the developing world, who verify business web addresses, phone numbers, e-mail addresses, and DUNS (Data Universal Numbering System) numbers through a combination of web research and direct phone calls.
Hyperspecialization reduces costs most dramatically when a company can turn to an expert instead of having to reinvent the wheel. For example, consider how much (expensive) time junior law associates spend researching the same legal precedents again and again in firms across the United States. Contrast that with the value a firm could realize by tapping into a network of experts who each specialize in some tiny aspect of the law. A firm might suddenly require knowledge of, say, the detailed rules and precedents associated with filing deadlines for U.S. antitrust cases, or the rules of evidence for murder trials in Texas. It could pay a hyperspecialist five times the hourly rate of a junior associate and still come out well ahead on costs.

Managing in a World of Hyperspecialization

In any given company, hyperspecialization might reshape the organization in many ways, from the macro to the micro level of task assignment. Some of the tasks of a certain role might be hived off, or entire job categories and processes might be upended. Managers might focus on lower-value-added tasks, as the clients of Samasource do when they hand over data entry. Or they might see greater value in tapping world-class expertise for high-end tasks. For instance, Business Talent Group and YourEncore have networks of freelance experts who provide clients with short-term, high-priced, but ideally higher-value consultation. Regardless of task level, capitalizing on hyperspecialization will call for new managerial skills and focus. First, managers will need to learn how best to divide knowledge work into discrete, assignable tasks. Second, specialized workers will have to be recruited and the terms of their contribution settled. Third, the quality of the work must be ensured. And finally, the pieces have to be integrated.

Breaking down the work. Understanding how a knowledge-based job could be transformed by hyperspecialization begins with mapping the tasks currently done by people holding that job. Such a map may immediately suggest tasks and subtasks that could be performed with higher quality, at greater speed, or at lower cost by a specialized resource. In 2008 the pharmaceutical giant Pfizer undertook to do just this in an initiative it called pfizerWorks. Its task-mapping revealed that Pfizer’s most highly skilled knowledge workers were spending 20% to 40% of their time on things like data entry, web research, basic spreadsheet analysis, and PowerPoint slides. The company established a process that allowed these tasks to be off-loaded, first to a pair of Indian offshoring firms and then also to an Ohio-based company.

Critical to subdividing knowledge work is understanding the dependencies among tasks and determining whether they can be managed satisfactorily if the tasks are done by different people. A simple example: A multinational company recently reorganized its administrative staff and considered assigning the task of making executives’ travel arrangements to a select group of administrative assistants who could then become its travel specialists. In the end the company decided that because travel itineraries impinge directly on the scheduling of other meetings (and on family birthdays and anniversaries), it was more efficient to leave this task with the administrative assistants who worked directly with the executives.

Recruiting workers and assigning tasks. To complete hyperspecialized tasks, companies can use internal employees, develop dedicated relationships with external suppliers, or rely on intermediaries that link clients with communities of specialized workers. One large U.S. technology company used its own staff when it experimented with hyperspecializing its internal software-development process. PfizerWorks relied on a small number of dedicated outsourcing companies. The T-shirt maker Threadless created its own community of workers to design and critique its products.

Hyperspecialization will require most managers to learn to work with the kinds of dedicated intermediaries that have sprung up in recent years to provide access to pools of skilled labor. (See the exhibit “The New Brokers of Work.”) Much as “cloud computing” services offer on-demand access to computer capacity and storage space, these firms offer “crowd computing”—on-demand access to large groups of appropriately specialized workers.

The intermediaries enable clients to accomplish tasks that range in size from tiny to quite large. On Mechanical Turk and Samasource, workers undertake small tasks that last a few seconds or minutes in exchange for payment ranging from several cents to several dollars. Project sites such as Elance and oDesk enable the completion of medium-size projects in many domains—including web development, graphic design, writing, and business analysis—for payments of several hundred to several thousand dollars.

Tasks may be used for creating spam or astroturfing.

Work can become dull and meaningless.

More work may be done with no guarantee of payment.

Workers may be subjected to more electronic surveillance.
THE BIG IDEA  THE AGE OF HYPERSONALIZATION

The New Brokers of Work

As evidence that the world of work is in flux, we’re witnessing the dramatic rise of a new class of intermediary—firms that connect enterprises with tasks to complete and communities of hyperspecialized workers.

Nearly all of them rely on a simple cost-plus business model, adding a surcharge to what the workers are paid. They differ in the scope of assignments they take on: Amazon’s Mechanical Turk brokers tiny tasks that may pay only cents, whereas TopCoder can handle large IT projects and related services such as the transfer of intellectual property.

If these niche start-ups can mature into larger-scale and more trusted suppliers of work, hyperspecialization will go mainstream. They will grow by ratcheting up their worker communities and client bases in tandem, ensuring that the former have ample projects to choose from and the latter have sufficient pools of talent to draw on. The leaders will be those whose security, project management, and quality control offer the greatest assurance.

GURU.COM, founded in 1997, claims more than 1 million registered members and enables talent searches in 220 skill-based service categories.

LIVEOPS, founded in 2000, employs more than 20,000 home-based agents to provide on-demand, pay-per-minute call center services.

1997 1998 1999 2000

ELANCE, founded in 1998, appeals to small businesses looking for graphic design, computer programming, web development, and writing help. By September 2000 it had more than $50 million in funding from top industry investors.

Integration. The last managerial challenge presented by hyperspecialization is the need to integrate separately produced pieces into a coherent solution. This means managing the three kinds of dependency described by Malone et al. in the March 1999 issue of Management Science: flow, sharing, and fit. The most obvious way to do that is to have someone in authority direct the process. Some experienced members of the TopCoder community become “copilots,” helping clients to define the contests and developers to get the information they need to compete effectively. Essentially, the copilots hyperspecialize in coordinating the work of other specialists. But other ways to integrate are often effective as well.

For example, in a flow dependency, tasks occur in a sequence, with later tasks reliant on the output of earlier ones. Software tools can often manage this by tracking task status and automatically passing work from one stage to the next. CastingWords uses specialized software tools first to route pieces of audio to the various workers who will transcribe them, then to detect and correct inconsistencies, and finally to assemble the transcribed pieces into a single document.

In a sharing dependency, more than one worker uses the same resource. A common way to manage dollars. InnoCentive and TopCoder undertake complex activities such as software development and scientific discovery for payments that can reach six or even seven figures.

Enterprises that already use hyperspecialization have developed a variety of innovative incentives for their communities of workers. Most of them pay, but many rely on other incentives as well. TopCoder, for instance, posts detailed individual performance statistics that are visible to the entire community, and members often go to great lengths to get their names on the list of top contributors. Another key motivator for many workers is the ability to select their own tasks. TopCoder’s founder, Jack Hughes, believes that this is a leading reason for his community’s high productivity.

As hyperspecialization becomes more common, attracting contributions from the most talented workers will become a critical success factor for many businesses. And it will increasingly resemble the way sales and marketing organizations now attract customers: by understanding what people want, figuring out how to give it to them, and learning how to keep them engaged. In fact, cultivating communities of workers is likely to become one of the key disciplines of 21st-century business.

Quality control. One way to ensure the quality of hyperspecialized work is to do what most companies do before they hire employees: check credentials. Some project-based intermediaries, including oDesk and Guru.com, still rely on this approach. But over the past decade several new approaches have emerged.

Paying on the basis of an outcome is one. For instance, when a contest is held on InnoCentive, the client does not pay until a solution to the problem has been developed. Users of Mechanical Turk don’t pay unless the work meets an acceptable level of quality. Another approach is to have multiple workers complete the same task and use only results that are replicated. A related method is to mix real tasks with test tasks for which the correct answer is already known. The intermediary CrowdFlower rejects contributions from people who get its test tasks wrong. Still another approach is to have one group of workers do the tasks and another group rate the outputs.

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this dependency is with various forms of markets and bidding. TopCoder’s programmers, for instance, often contribute to—and reuse modules from—a library of software components. Those who contribute are paid a royalty when others use their work. The time of people potentially available to do tasks is another critical shared resource; all the intermediaries listed above use fixed-price or bidding markets to manage this dependency, too.

A fit dependency occurs when separate outputs must be integrated into a whole. Modular architecture and standards can be effective in managing fit. TopCoder develops an overall architecture in the early stages of its projects, with well-defined interfaces between software modules. Once the architecture is in place, the modules can be developed simultaneously, speeding the overall process.

A surprising example of managing fit comes from a prototype system called CrowdForge, developed by researchers at Carnegie Mellon University. It addresses a question some people might find unthinkable: Can a piece of high-quality prose be assembled from the output of people working on small bits of it in isolation? CrowdForge came up with an answer by using Mechanical Turk workers to write encyclopedia articles. First it asked some workers to write outlines for the articles. Then others were instructed to collect facts for different sections of the outlines. Still others used those facts to write paragraphs for each section. Finally, the system automatically concatenated the paragraphs according to the original outlines. Independent evaluators found that the articles were of higher quality than articles produced by single authors at the same cost.

Of course, we don’t know how far a hyperspecialized approach to writing might go. But perhaps business reports, proposals, and other documents written by a single person will someday be as rare as handcrafted clothing and furniture are today.

**Good News, Bad News**

Hyperspecialization offers significant advantages for companies, workers, and society as a whole. But it has a potential dark side, which must be addressed. Although many of these advantages and disadvantages also occur with the outsourcing and distribution of work, they arise in specific ways with hyperspecialization.

**The promise.** Hyperspecialization offers both workers and companies much more flexibility than traditional employment arrangements do. Individuals can often work where and when they choose. Agents for LiveOps, which provides call center outsourcing, find this flexibility very attractive, because it allows them to operate from home and makes it easier to balance work with personal responsibilities. And the autonomy workers feel when they can choose their own assignments has a strong appeal. For companies, hyperspecialization allows capacity to be ramped up and down very rapidly. In the wake of Hurricane Katrina, the Red Cross hotline was overwhelmed with calls from people offering to contribute or volunteer. The agency quickly engaged 300 LiveOps agents, who handled more than 17,000 calls over the next few days.

Hyperspecialization can also ameliorate the skills mismatch that plagues many national labor markets. Even with today’s high rates of unemployment, companies around the world find it increasingly difficult to hire certain key employees, such as sales representatives, engineers, and accountants. These shortages might be alleviated by redefining jobs so

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**INNOCENTIVE**, the first global web community for open innovation, was created in 2001. It stages competitions in which “solvers” of science and technology problems respond to the challenges of “seekers.”

**ODESK**, founded in 2003, reported in 2009 that payment for services through its site had exceeded $100 million. Most of its workers are located outside the U.S.

**CASTINGWORDS**, founded in 2005, provides transcription services to its clients, parceling the audio files out to online typists.

**MECHANICAL TURK**, launched in 2005, was initially developed to distribute Amazon’s own tasks; it’s now available to others in need of small jobs best performed by humans.

**CROWDFLOWER** started providing labor on demand to verify information and categorize images and text in 2007.

**TOPCODER** began hosting algorithm competitions in 2001 to let coders show off their chops. Over time it has become more oriented toward staging design and development competitions contracted for by clients.
that, for example, skilled accountants coordinated the work of hyperspecialists doing the lower-skilled aspects of the job.

People who face barriers in traditional job markets might benefit from hyperspecialization as well. At web-enabled intermediaries, workers are typically judged by what they produce—not by résumés, prior experience, or references. This can be liberating for young people looking for a first break, seniors seeking to stay connected to the work world, or those who risk discrimination in face-to-face workplaces. Pearl Interactive Network, an Ohio-based company that performs outsourced tasks for pfizerWorks, primarily employs people with disabilities.

Hyperspecialization also provides virtual labor mobility for people who live in developing countries. Wages in advanced economies can exceed those in some emerging nations by as much as a factor of eight. Being able to undertake small tasks on sites like Samasource and txteagle can thus significantly improve the economic standing of workers in, say, Africa and South Asia.

The perils. A cloud looming over the future of hyperspecialization is the possibility that it will facilitate what the Harvard law professor Jonathan Zittrain calls “digital sweatshops,” where workers are exploited for very low wages. These wages result in part from labor market arbitrage. What are viewed as sweatshop wages in advanced economies can be quite attractive to workers in developing countries. But as economic development worldwide advances in the coming decades, labor market arbitrage will become less common, and at least some of this wage gap is likely to close. And, of course, the exploitation of workers is not confined to the web. A recent survey by a researcher at Harvard's Berkman Center for Internet & Society showed that workers judged Mechanical Turk employers to be fairer than the typical offline employer.

Another concern is that dividing work into minuscule fragments allows the unscrupulous to conceal the goals toward which workers’ efforts are directed. Thus workers may unknowingly be contributing to something counter to their personal beliefs. A recent study of Mechanical Turk suggested that more than 40% of the tasks on the site may be related to creating spam or astroturfing (designing political or corporate advocacy to give the appearance of a grassroots movement). This highlights a related problem: Small-task intermediaries like Mechanical Turk have made it easier to game the internet.

And when work is divided into tiny tasks, it may become dull and meaningless, perhaps even producing ill psychological effects on the people who perform it. Adam Smith himself warned against a too-fine division of labor, noting the deleterious results when a person’s work was reduced to “a few very simple operations.”

Two other potential problems are the growing amount of work done on spec (that is, with no guarantee of payment) and the increased surveillance of electronically connected workers. Neither is unique to hyperspecialization: Spec work has long been prevalent in fields like graphic design and writing, and close surveillance of workers is still common in factories. But the contest-based business models of some intermediaries rely much more heavily on spec than typical freelancers’ work arrangements do. And other intermediaries have pushed electronic surveillance to a degree many find ominous.

Finally, over the long term hyperspecialization may eliminate certain kinds of jobs, just as the Industrial Revolution eliminated some traditional crafts. During the industrial era, social mechanisms eventually emerged to manage employment arrangements, but the transition was wrenching. A move into the age of hyperspecialization could prove equally so.

The path forward. How might we address some of the less attractive aspects of hyperspecialization? Currently, a patchwork of regulations, mostly designed for the industrial era, govern work—including hyperspecialized work. Each country or region has its own rules. If roughly comparable rules were adopted across national boundaries, through either agreed-on company standards or new government regulations, egregious exploitation or deception could be reduced, along with uncertainty for both companies and workers. The goal would be to create the equivalent of a free-trade zone in which workers were protected, companies got the work they needed, and governments collected the appropriate taxes.

Establishing global rules and practices to govern hyperspecialization would be a big challenge. On one hand, the very concept of hyperspecialization cuts against the grain of many countries’ labor regulations, especially in the European Union. On the other hand, some developing economies may well resist any rules or standards, fearing they would curb growth. It might be possible to reframe knowledge work undertaken on the web as a form of international trade. Thus global rules for the exchange of knowledge work might create win-win outcomes—much as the
loosening of trade restrictions, first under GATT and then under the WTO, has enabled a massive expansion of trade in goods since World War II.

Mechanisms are needed for hyperspecialized workers to develop skills over time and to transfer their work records from one intermediary to another. Those who operate online from home may also want to connect with peers to share war stories or simply to vent. In prior writings we have called for the rise of a new form of guilds to provide the dispersed digital 21st-century workforce with professional development and a sense of community. The New York–based Freelancers Union and other independent-worker organizations have emerged to help fill this void; hyperspecialization intermediaries could do so as well.

Work divided into ever tinier parts doesn’t necessarily lose meaning. Medical specialists, for instance, often focus on very narrow aspects of keeping people healthy but continue to find their work rewarding. And unlike specialized workers in a factory, who do the same tasks all day, digital hyperspecialists can easily construct personal portfolios of tasks. An engineer, for instance, might spend part of a day working on a difficult challenge for InnoCentive and then relax by doing some less demanding work on Mechanical Turk.

**The Advancing Frontier**

No discussion of the future of knowledge work should neglect to mention artificial intelligence, whereby computers take over tasks formerly performed by people. One recent example is a new generation of software tools that analyze massive amounts of text. Used during the discovery phase of lawsuits, this software can accomplish what young associates at law firms once did by laboriously reading box after box of documents. In the future some first-generation hyperspecialization initiatives will become viable candidates for pure automation. In many other areas artificial intelligence will enable or augment hyperspecialization, by automating some tasks or managing portions of the process. Given the march of technology, firms that want to take advantage of hyperspecialization should continually monitor the potential for fully automating certain knowledge work.

Hyperspecialization is the human cousin of the information technology tools that have become available to businesses over the past few decades. In the case of computer technologies, the simple act of buying and deploying them was not enough: Companies that used these new tools wisely, in concert with organizational innovations and people practices, gained an edge. Hyperspecialization presents a similar opportunity. How companies use it will determine which ones achieve competitive advantage.

Many first-generation experiments with hyperspecialization have relied on intermediaries like Mechanical Turk and TopCoder. But as it becomes more prevalent, enterprises will most likely try using it to organize their internal activities as well. And new kinds of intermediaries may step in—governments that want to create employment for their citizens, for example, or organizations that represent workers’ interests.

We envision the emergence of a rich ecosystem—for-profit firms, government agencies from many nations, and nonprofits, all governed by global rules and standards—to support hyperspecialization. It would be much like today’s web, except that instead of enabling the exchange of information and goods, it would convey a pulsating, world-spanning flow of knowledge work.

**Thomas W. Malone** is the Patrick J. McGovern Professor of Management at the MIT Sloan School of Management and the founding director of the MIT Center for Collective Intelligence. He is the author of *The Future of Work: How the New Order of Business Will Shape Your Organization, Your Management Style, and Your Life* (Harvard Business Review Press, 2004). **Robert J. Laubacher** is a research scientist and the associate director of the MIT Center for Collective Intelligence. **Tammy Johns** is the senior vice president of innovation and workforce solutions for ManpowerGroup.