Silicon Flatirons
A Center for Law, Technology, and Entrepreneurship at the University of Colorado

Silicon Flatirons Roundtable Series:
Emerging Shapes of Higher Education

Thursday, June 11, 2015, 1:00 PM - 4:00 PM
University of Colorado Law School, Colloquium Room 480

ADDITIONAL BACKGROUND SOURCES

Mystery Murphy, *Boundary Jumping: Understanding the Value of Modest Anarchy in Entrepreneurial Networks,* SILICON FLATIRONS CENTER (Jan. 2014), *available at h*ttp://www.silicon-flatirons.org/documents/publications/report/201401BoundaryJumpingReport.pdf.

C.F. Kurtz & D.J. Snowden, *The New Dynamics of Strategy: Sense Making in a Complex and Complicated World,* 42 IBM SYSTEMS J. 3 (2003).

Mary Godwyn, *Can Liberal Arts and Entrepreneurship Work Together,* American Association of University Professors, *available at* http://www.aaup.org/article/can-liberal-arts-and-entrepreneurship-work-together#.VRS00fnF9ps.

IBM's Role in Creating the Workforce of the Future, BEYOND IT (Sept. 2009), *available at* http://www-05.ibm.com/de/ibm/engagement/university_relations/pdf/Beyond_IT_report_IBM_Workforce_of_the_Future.pdf.

Silicon Flatirons
A Center for Law, Technology, and Entrepreneurship at the University of Colorado

*Roundtable Series on Entrepreneurship, Innovation, and Public Policy**

Boundary Jumping:
Understanding the Value of Modest Anarchy in Entrepreneurial Networks

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January 2014

Colorado Law
University of Colorado Boulder

*The Silicon Flatirons Roundtable Series on Entrepreneurship, Innovation, and Public Policy is sponsored by Brad Feld, Managing Director of the Foundry Group. This is the 33rd Flatirons Report. More Reports – on topics including private equity, internet governance, cloud computing, angel investing, and modern pedagogy – can be found at http://www.siliconflatirons.com/publications.php?id=report. Roundtable and Summit discussions further the Silicon Flatiron Center's goal of elevating the debate around technology policy issues

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Executive Summary

Matt Cutter, CEO and Founder of Upslope Brewing in Boulder, Colorado, had a problem. His upstart craft brewery needed a technology to enable faster and more efficient canning of small batches of beer. Finding a dearth of satisfactory solutions on the market, Cutter did something that might seem curious. He engaged an engineering firm collocated in his building, Wild Goose Engineering, that knew nothing about beer or canning. Wild Goose's expertise was instead in engineering, manufacturing, and fabricating products ranging from firefighter safety gear to airplane parts. In its collaboration with Upslope, Wild Goose nonetheless drew upon its diverse experience to design a new filling system that enabled far faster canning. The results were remarkable. So successful, in fact, that Wild Goose now exclusively manufactures craft brewing canning systems.[1]

Wild Goose's innovation in working with Upslope is an example of *boundary jumping*. Boundary jumping involves the exchange of information and knowledge between people across different industry sectors and disparate intellectual disciplines. Searching for new insights across boundaries might appear to be a recipe for inefficient and wasteful exploration. Mounting evidence, to the contrary, suggests the powerful effects of combining knowledge and experience across industries and disciplinary domains. Indeed, a better understanding of boundary jumping may be a key that unlocks greater creativity for startups in Colorado's Front Range.

On November 15, 2013, the Silicon Flatirons Center convened a roundtable (the "Roundtable") featuring entrepreneurial leaders from a diverse range of industries. The Roundtable analyzed how boundary jumping works and, additionally, where it already occurs among startups in the Front Range. Roundtable participants discussed their own experiences with boundary jumping and opined on structures and skills that facilitate increased opportunities for innovation. As this report details, boundary jumping occurs where the "modest anarchy" of Boulder's Pearl Street facilitates interactions between entrepreneurs, where serendipitous conversations between different companies arise as designed by the architects of Denver's Galvanize, and where digital messages in a bottle are broadcast as "problems" for unknown others to solve via the Internet.

A growing body of literature suggests that boundary jumping enhances the innovative capacity of companies. This is because creativity and innovative problem solving are best understood as collective activities that are "always the result of new combinations of pre-existing know-how, skills, ideas, processes and artifacts."[2] Consistent with the academic literature, Roundtable participants overwhelmingly agreed that boundary jumping engendered unexpected and positive innovations for their businesses. They further underscored that a better understanding of boundary jumping could provide insight about how startups can better innovate.

While boundary jumping is an important part of creativity, it often fails to occur. Boundary jumping cannot occur or will not be productive if individuals or organizations: (1) do not have the opportunity to interact, and/or (2) cannot process or understand the information they are receiving

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[1] This innovation has expanded the number of small microbreweries that can their own beer, allowing for a significant expansion of the industry in Colorado and the United States. Alicia Wallace, *Boulder-Area Firms Benefit from Craft Beer's 'Ripple Effect,'* dailycamera.com (May 15, 2012) *available at* http://www.dailycamera.com/business_old/ci_20632132/boulder-area-firms-benefit-from-craft-beers-ripple.

[2] Pierre Desrochers and Samuli Leppälä, Opening up the 'Jacobs Spillovers' black box: local diversity, creativity and the processes underlying new combinations, 11 JOUR. ECON GEOG 843, 846 (2011).

from their boundary jumping counterpart. Importantly, individuals must be spatially *and* cognitively proximate to one another in order for successful boundary jumping to occur.

Spatial proximity refers to convening – or at least bridging – participants across industry sectors and intellectual domains. Urban architecture, problem solving websites, and cross-industry social groups are each examples of structures that increase spatial proximity. Desired interactions can be intentional or serendipitous and moreover, structures that facilitate spatial proximity can be physical or virtual. Effective structures for innovation are those that enable more frequent and productive interactions across boundaries than would otherwise occur in the absence of such structures.

Boundary jumping further requires that individuals be *cognitively proximate* to one another. Cognitive proximity determines whether people involved in an interaction can understand, process, and use the information exchanged across industry and intellectual boundaries. If concepts are not accessible, such as when terminology and jargon makes communication mutually unintelligible, then boundary jumping fails. The ability to make useful associations across boundaries is predicated on cognitive proximity.

Significantly, an individual's cognitive proximity and ability to effectively boundary jump is not fixed. This insight has important implications for education. Particularly as computers and machines assume work that can be routinized and automated, the uniquely human role in creativity will become even more important to prospective employers and competitive organizations. In order to produce individuals who are creative and capable of innovation, education would be well served to focus on teaching skills that facilitate boundary jumping and increase an individual's cognitive capacity to reach across borders in mutually intelligible ways.

Of course, this may be easier said than done. For example, specialization poses distinct challenges to boundary jumping. The type of deep expertise required to access the insights of a specialized discipline can create cognitive boundaries in an individual that are difficult to span. Generalist skills, concomitantly, are difficult to cultivate due to the time demands associated with specialization. Despite these challenges, this puzzle may be worth solving. This is because creativity and innovative problem solving are best understood as collective enterprises that involve reaching across boundaries to change existing domains and ways of thinking or to produce new innovations. The Roundtable participants agreed that cultivating these boundary jumping skills will be increasingly important even as specialization proliferates in the workplace.

As part of its mission to architect conditions that make innovation more likely to occur, the Silicon Flatirons Center produced this report (the "Report") to summarize and expand the Roundtable discussion. By connecting the Roundtable discussion to relevant research in the areas of creativity and entrepreneurial networks, this Report illuminates the structures and cognitive skills that enable productive boundary jumping. It proceeds in three parts. Part I elaborates upon the concept of boundary jumping and provides examples of the innovations that occur when boundary jumping takes place. The Report then turns to examining how boundary jumping can be promoted. Part II surveys different types of structures that facilitate boundary jumping by bridging spatial proximities. These structures range from city architectures to organizational cultures within companies. Part III then describes the cognitive skills that aid individuals in boundary jumping. Namely, these skills reduce the cognitive distances between individuals, making them more cognitively proximate to one another.

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Part I. The Promise of Boundary Jumping

The more we learn about innovation and creativity, the more boundary jumping emerges as a prominent enabling feature. Research by Pierre Desrochers and Samuli Leppälä, for example, finds that cross-industry innovation happens through three processes: (1) adding to or exporting specific know-how to different industries, (2) importing information to a new industry or discipline, and (3) formal or informal collaboration with those from different intellectual disciplines.[3] In essence, creativity is a process in which information is transferred across boundaries and combined in novel ways.[4] Increasingly, organizations and businesses take heed of the promise of boundary jumping and seek to engage with firms and individuals across industries in productive and useful ways.

InnoCentive.com illustrates the power of applying information from one industry to seemingly unrelated areas. InnoCentive is a crowdsourcing innovation platform that broadcasts difficult and unsolved scientific problems to a wide range of potential problem solvers. Potential solvers come from nearly 200 countries and are trained in a diverse number of disciplines. Client companies pay problem solvers if they provide an acceptable solution.

Notably, since 2001, 85% of the problems posted on InnoCentive.com have been solved. Problems that client companies had spent decades working on internally have been solved on the InnnoCentive website within two weeks and at a fraction of the price of traditional research and development.[5] Researcher Karim Lekhani inquired about InnoCentive's success. Lekhani found that the heterogeneity of scientific disciplines represented by solvers on the website was the key to problem solving success. Specifically, Lekhani found that the "further the focal problem was from the solver's expertise, the more likely they were to solve it."[6]

Normally, scientists within an organization are trained in a specific scientific discipline. They are trained to problem solve within a certain set of parameters. The broadcast problem solving that occurs on Innocentive.com, on the other hand, presents the problem to solvers from heterogeneous scientific backgrounds. A solver from a different background can approach the problem by applying knowledge that is commonplace in one discipline to an unfamiliar discipline in unique and novel ways. This demonstrates the power of bringing "outside" expertise to a problem.

Broadcast problem solving also provides insight into the motivations of those who problem solve within this structure. While organizations that post their problems to InnoCentive.com offer financial rewards for successful solutions, Lekhani found that successful solvers were more strongly driven by enjoyment-based intrinsic motivations than they were by pecuniary reward. This research suggests that when architecting challenge-based boundary jumping structures, organizers may not need to offer pecuniary reward to adequately incentivize the boundary jumping to occur. In fact,

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[3] Pierre Desrochers and Samuli Leppälä, Opening up the 'Jacobs Spillovers' black box: local diversity, creativity and the processes underlying new combinations, 11 JOUR. ECON GEOG 843, 846 (2011).
[4] *Id.*
[5] Karim R. Lekhani, *The Value of Openness in Scientific Problem Solving*, HBS Working Paper No. 07-050, *available at* http://www.hbs.edu/research/pdf/07-050.pdf.
[6] Indeed 72.5% of successful solvers worked from solutions previously developed in other domains. Karim R. Lekhani, *The Value of Openness in Scientific Problem Solving*, HBS Working Paper No. 07-050, *available at* http://www.hbs.edu/research/pdf/07-050.pdf.

research suggests that under certain problem solving scenarios, an individual's intrinsic interest in problem solving may actually be reduced if pecuniary reward is present.[7]

While the success of InnoCentive.com illustrates the promise of boundary jumping, the fact remains that boundary jumping does not occur often enough. This highlights the need for a deeper understanding of boundary jumping. In particular, two trends – hyperspecialization and organization's need for innovation – underscore the urgency to better understand boundary jumping. Each of these is addressed in turn.

A. Boundary Jumping in an Age of Hyperspecialization

Knowledge exchange across boundaries, as InnoCentive illustrates, is often identified as a key to innovation. The larger the distances between the knowledge of the parties or disciplines interacting, the greater potential there is for material innovation to occur. At some point, however, parties intending to share information may have too great a cognitive distance between them to make the interaction productive. This is because individuals have an *absorptive capacity* to understand, interpret, and evaluate the world that is framed by their physical, social, and institutional environments.[8] At some point, differences in absorptive capacity will be so great, and the cognitive distance between the two so large, that they will be unable to communicate effectively.[9] Where this occurs, boundary jumping fails.

Specialization has been touted as a model for the division of labor since Adam Smith's *The Wealth of Nations*. But some economists and organizational theorists assert that the current state of technology is enabling us to enter into an age of hyperspecialization.[10] Trends towards hyperspecialization are accelerated by policymakers who assert that a focus on specialized skills will make students more employable.[11] While there is evidence that there is more demand for technically skilled workers than there is a supply, one downside of hyperspecialization is that it potentially leads to greater cognitive distances between individuals and industries, thereby making useful knowledge exchange more difficult.

This highlights the need for organizations and individuals to facilitate more effective boundary jumping. Hyperspecialization of course makes boundary jumping more difficult. But it need not be a barrier to productive boundary jumping. Many organizations and individuals have found effective ways of bridging or reducing the spatial and cognitive distances between hyperspecialists to facilitate boundary jumping innovations.

The design firm IDEO, for example, illustrates how individuals can position themselves to bridge the cognitive distances between disparate groups of hyperspecialists. IDEO is a product

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[7] Edward L. Deci, *Intrinsic Motivation, Extrinsic Reinforcement, and Inequity*, 22 JOURNAL OF PERSONALITY AND SOCIAL PSYCHOLOGY 119 (1972).
[8] Bart Nooteboom, Learning by Interaction: Absorptive Capacity, Cognitive Distance and Governance, 4 JOURNAL OF MANAGEMENT AND GOVERNANCE 69, 73 (2000).
[9] Bart Nooteboom, Learning by Interaction: Absorptive Capacity, Cognitive Distance and Governance, 4 JOURNAL OF MANAGEMENT AND GOVERNANCE 69, 73 (2000).
[10] Thomas W. Malone, Robert J. Laubacher & Tammy Johns, *The Age of Hyperspecialization,* HARVARD BUSINESS REVIEW 56 (July/August 2011).
[11] Dylan Scott, *Should Universities Move Away From a Liberal Arts Education?*, Governing.com (April, 29 2013), *available at* http://www.governing.com/blogs/view/gov-should-universities-move-away-from-liberal-arts-education.html.

design consulting firm that works in over 50 industries. Strong connections spanning diverse industries enable IDEO's engineers to create innovative products that combine technologies from different sectors in novel ways.[12] Specifically, the engineers at IDEO are trained and encouraged to find novel associations between seemingly unrelated pieces of information. IDEO is successful in boundary jumping because it has ensured that its engineers have mechanisms by which to capture good ideas, keep them alive, and test promising concepts in novel ways.[13] These processes allow IDEO engineers to bridge cognitive distances between unrelated fields and disciplines that are rife with hyperspecialists.

B. "Search and Reapply": Organizations That Value Boundary Jumping

Many businesses have traditionally been organized as autarkic, proprietary, and insular. In a stable and slow changing marketplace, a strategy of closed firm boundaries can help protect intellectual property, while a strategy of separate units within an organization can enhance accountability and facilitate specialization. Increasing evidence, however, suggests that these structures are antithetical to rapid innovation. Looking outside of one's own firm for novel innovations has proven successful for many companies. Accordingly, firms increasingly adopt organizational cultures that value boundary jumping interactions both within and outside the company. Pixar, Modular Robotics, and Proctor & Gamble are each examples of organizations that have embraced structures that reduce the spatial and cognitive distance between individuals.

Pixar illustrates how an organization's physical structures can be architected with the intention to bring hyperspecialists together.[14] As Pixar Chief Creative Officer John Lasseter says, "Technology inspires art, and art challenges the technology."[15] Collaboration between computer scientists and animators has been at the core of Pixar's success from the beginning. Pixar eschewed housing their programmers and artists in different departments and locating them in different buildings as many production companies do. Pixar instead forces the two disciplines to collaborate on a daily basis by physically convening different hyperspecialists and forcing them to learn to communicate in mutually intelligible ways. Many believe it is the intersection between technology and liberal arts that have allowed Pixar to push technological boundaries while making each one of its movies a significant commercial success, grossing on average $555 million internationally.

Roundtable participant Erik Schweikardt, the CEO and Founder of Modular Robotics, a company that produces robotic construction kits for kids, also underscored power of having scientists and artists collaborate. Modular Robotics achieved success with its first product, Cubelets. Despite this success, Schweikardt was concerned that the product only appealed to a narrow subset of young boys. In designing their second product, known as Moss, Modular Robotics set out to create a design that appealed to a wider audience. The Modular Robotics team, however, realized that they lacked the storytelling skills to create the type of product they were looking for. Inspired by another local company, KidRobot, which produces designer vinyl toys, Schweikardt brought in a group of local street artists to collaborate with the Modular Robotics engineers. The result is a Moss

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[12] *See* IDEO Fact Sheet, *available at* http://www.ideo.com/images/uploads/home/IDEO_Fact_Sheet.pdf.
[13] Andrew Hargadon, *The Best Practices of Technology Brokers*, HBS Working Knowledge Archives, Aug. 4, 2003, *available at* http://hbswk.hbs.edu/archive/3613.html.
[14] Jonah Lehrer, *Steve Jobs: "Technology Alone Is Not Enough"*, THENEWYORKER.COM, Oct. 7, 2011, *available at* http://newyorker.com/online/blogs/newsdesk/2011/10/steve-jobs-pixar.html
[15] Jonah Lehrer, *Steve Jobs: "Technology Alone Is Not Enough"*, THENEWYORKER.COM, Oct. 7, 2011, *available at* http://newyorker.com/online/blogs/newsdesk/2011/10/steve-jobs-pixar.html

design that includes all the technical robotic complexity of the Cubelets product, along with the playfulness and aesthetics of hand-painted KidRobot toys. Schweikardt believes the company crafted a product that was greater than the sum of its parts.

Roundtable participant Kirk Holland, a venture capitalist with Access Venture Partners, highlighted that Proctor & Gamble, where he started his career, created an institutional culture that encouraged looking outward for innovation. P&G refers to this technique as "search and reapply." By investing money in business activities that look outside the firm and outside the industry, P&G established a culture in which boundary jumping is systemically encouraged. Today, in his role as venture capitalist, Holland encourages the *search and reapply* culture. When portfolio companies are dealing with a certain challenge or problem, Holland encourages them to consider who best deals with this challenge that is not in the startup's category. He challenges startups to look outside of their industry and to boundary jump as a method for problem solving. Holland noted that technology such as LinkedIn has made finding and connecting innovators in other industries easier than ever. Hence, these cultures and technologies make unrelated industries more spatially proximate to one another, meaning innovation is more likely to occur.

Overall, the success of firms that embrace boundary jumping strategies illustrate the value of bridging or reducing the spatial and cognitive distances between specialists. This is increasingly important as industries continue to fragment and universities focus increasingly on teaching specialized skills. But how are spatial and cognitive distances reduced or bridged? Parts II and III next turn to these issues.

Part II. Modest Anarchy: Structures To Reduce Spatial Distance

A common sense strategy to reduce the spatial distance between individuals is to design architecture that facilitate opportunities for boundary jumping to occur. The Roundtable identified at least four different types of structures that facilitate spatial proximity and engender boundary jumping: (A) physical architecture, (B) broadcast mechanisms using open platforms, (C) removing labels to better leverage user generated content, and (D) cross-industry social networks. Each of these structures is described below.

A. Physical Architecture of the Space in Which We Work and Live

The corner office and quiet cubicle are a thing of the past in many modern workspaces. This is because the myth of the lone genius innovating in a quiet locked office has been debunked. Increasingly, what we know about the way that humans learn, interact, and innovate tells us that our physical spaces need to be open and shared. This insight can be applied across a spectrum of physical spaces ranging from the landscape of a city to the set up of a single office, all of which are structures that help facilitate boundary jumping by increasing spatial proximity.

Cities have long been an important focus of economic geography, and by architecting certain urban spaces, boundary jumping interactions can be accelerated. Urban theorist Jane Jacobs asserted that dense city spaces that force interactions across boundaries are the most successful in driving innovation.[16] Moreover, Jacobs argued that knowledge spillovers in a dense city space are most productive economically when the local economic base is made up of diverse industries. Jacobs'

[16] Jane Jacobs, *The Economy of Cities*, New York: Random House (1969)

claims about dense urban spaces is supported by evidence that shows that cross-industry boundary jumping leads to more productive results when the individuals involved can have face-to-face interactions.[17] Urban spaces allow diverse individuals, who would otherwise be unlikely to interact, to connect in face-to-face interactions which allow for unexpected connections and inspiration.[18]

Roundtable participant Clif Harald agreed with Jacobs' theories. Harald cited the failure of many urban redevelopment plans of the 1970's and 1980's as evidence that dispersed city spaces are less productive than dense ones. In contrast, Harald pointed to Boulder's Pearl Street Mall as an example of a dense urban space in which unplanned interactions occur. When a diverse set of businesses are located in a small geographical area, serendipitous boundary jumping interactions occur in the streets, in coffee shops, and in restaurants. Borrowing lexicon from another Roundtable participant, Alicia Gibb, Harald suggested that urban spaces are sufficiently dense for boundary jumping when they facilitate "modest anarchy." When the space allows for modest anarchy, unplanned but productive boundary jumping collisions can occur.

Moving inward from the cityscape, another physical structure that can be reworked to facilitate boundary jumping is the workspace. Creating an open and shared space where people are not physically separated is an important way to facilitate unplanned interactions. This was the goal of the massive Pixar Atrium – initially chided as a waste of space – that Steve Jobs envisioned as a space where serendipitous collisions would occur between Pixar employees with different specialties and working on disparate projects.

Similarly, creating an open and collaborative workspace that encourages boundary jumping interactions is something that Roundtable participant Jim Deters focused on in co-founding Galvanize, a coworking space for startups. In planning the space, Deters said it was important to find a space that was not too large – 30,000 square feet at most – so that it could remain open, communal, and mostly single story. The space also includes a bar and coffee shop designed to create more opportunities for unplanned interactions. This aligns with research about workplace habits which finds that 80% of workplace communications are informal and that workers are highly unlikely to communicate if they are not visible to one another.[19] Finally, Deters spoke about mindfully designing the Galvanize space to engender a sense of community and trust. The importance of creating a space in which people from diverse backgrounds feel comfortable to interact and share is supported by research that shows that building mutual trust is important in bridging the cognitive distance between individuals who are attempting to boundary jump.[20]

Caution is warranted, however, insofar as human behavior does not always flow in the way that planners hope. While Pixar and Galvanize are examples of workspaces successfully architected to facilitate boundary jumping, well intentioned communal workspaces can fail to bring diverse groups together as planned. Roundtable participant Charisse Bowen spoke about the experience of

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[17] Pierre Desrochers and Samuli Leppälä, Opening up the 'Jacobs Spillovers' black box: local diversity, creativity and the processes underlying new combinations, 11 JOUR. ECON GEOG 843, 857 (2011).

[18] Pierre Desrochers and Samuli Leppälä, Opening up the 'Jacobs Spillovers' black box: local diversity, creativity and the processes underlying new combinations, 11 JOUR. ECON GEOG 843, 857 (2011).

[19] Backhouse A. & Drew P., *The design implications of social interaction in a workplace setting*, 19 ENVIRONMENT AND PLANNING B: PLANNING AND DESIGN 573-584 (1992).

[20] Pierre Desrochers and Samuli Leppälä, Opening up the 'Jacobs Spillovers' black box: local diversity, creativity and the processes underlying new combinations, 11 JOUR. ECON GEOG 843, 857 (2011).

the Rocky Mountain Innosphere, a non-profit business incubator, and their new facility constructed in 2011 which was funded primarily by the City of Fort Collins. The Rocky Mountain Innosphere was a well-intentioned project meant to provide flexible workspace for entrepreneurs in Northern Colorado. The developers of the building did not take into full consideration functional communal workspace needs and space proximity options to encourage boundary jumping behavior. As a result, the Rocky Mountain Innosphere created a space that was poorly designed to facilitate spatial proximity. Where Galvanize created a space that is wide open, the Rocky Mountain Innosphere building features multiple levels that physically separate tenants. The Rocky Mountain Innosphere thus stands as an example of how physical space can unintentionally impede useful interactions across boundaries.

B. Broadcasting Problems Across Industries on an Open Platform

One structure that has been notably successful in facilitating boundary jumping is the use of technology to broadcast problems out to a wide range of audiences. Broadcasting a problem to the world is not something that was easily facilitated before the Internet, nor does it fit with traditional business customs that heavily guard intellectual property and proprietary business practices. The rise of the free and open source software communities, however, has furthered the norms of openness in information sharing, and an increasing number of companies are sharing their problems with outsiders through the internet. As such, the broadcasting of problems over the Internet is a structure that virtually makes individuals more spatially proximate; driving innovation at a startling rate.

InnoCentive, as highlighted in Part I *supra*, illustrates the innovative results of boundary jumping in broadcast problem solving. Broadcast search makes disciplines or individuals more spatially proximate to one another by convening diverse disciplines in a virtual platform and creating the opportunity for boundary jumping. "Broadcast search leverages pre-existing knowledge and the creative recombination and transformation of knowledge in solution generating processes."[21] Often, this importation and recombination of information from one domain to another reduces computation time significantly.

The insights of Lekhani's research of the InnoCentive.com website were echoed by Roundtable participant Nathan Seidle, the CEO and Founder of SparkFun Electronics. As a business that is built on open source hardware, SparkFun operates within an environment where openness and access to information is built into every product they put on the market. This has allowed SparkFun to tap into the knowledge and resources of the open source community around the world. For example, SparkFun was interested in purchasing a laser scanner that was a close sourced item, i.e. the SparkFun engineers could not figure out how to "talk to" the scanner and the company that produced the scanner would not provide SparkFun with the source code necessary to interface with the scanner. In response, SparkFun posted what they knew about the scanner on their website and within two days, someone in France had reverse engineered the code. Seidle explained that in the open source world, individuals are motivated by giving back to the community and collective problem solving. Hence, by broadcasting its problem and by being a prominent part of the open source community, SparkFun has been able to tap into the shared resources of individuals all over the world. In essence, SparkFun has architected a structure in which it can effortlessly interface

[21] Karim R. Lekhani, *The Value of Openness in Scientific Problem Solving*, HBS Working Paper No. 07-050 at 9, *available at* http://www.hbs.edu/research/pdf/07-050.pdf.

and boundary jump with individuals from other domains all over the world, reducing the spatial distances between them.

C. Removal of Labels and Credentials In User Generated Content

A recurring theme of the Roundtable was that boundary jumping structures, whatever their form, are most effective when they lack hierarchy or labels and when they allow for a certain amount of "modest anarchy." The Roundtable participants anecdotal evidence all seemed to point to the fact that boundary jumping was most successful and led to innovation most often when it occurred in environments that evolved organically. This is due to the fact that spatial proximity occurs more often within environments where organic interactions are allowed to develop.

Alicia Gibb, who founded and runs the Open Source Hardware Association, introduced the concept of anarchic spaces to the Roundtable discussion. Gibb offered hacking spaces as examples of "platforms of anarchy" where boundary jumping interactions occur with modest direction. Specifically, people from diverse backgrounds come together to share tools and knowledge and collaborate creatively without being told what to work on. By convening diverse disciplines and allowing individuals to create for the sake of creation, hacker spaces and other environments of "modest anarchy" facilitate the spatial proximity necessary for boundary jumping.

The freedom that hacker spaces give to those who work in them and the creative interactions that freedom engenders is similar to the boundary jumping interactions that occur in House of Genius sessions. The House of Genius, founded by Roundtable participant Toma Bedolla, is a boundary jumping platform with the goal of bringing a diverse group of people together to engage in disruptive and creative problem solving. During a House of Genius session, participants who are typically strangers, convene for a 2-3 hour session. Participants do not reveal their experience, credentials, or titles. Two or so businesses will present a problem they are facing. The full group, then collectively "hacks" the companies' problems. In Bedolla's experience, the anonymity among participants allows good ideas to rise to the top without fear of being dismissed for their lack of experience. On the other hand, poor ideas are not overvalued because they come from someone who is experienced and *should* have good ideas.

The importance of removing credentials was echoed by Nathan Seidle of SparkFun. Unlike the *actual* credentials that are removed in the House of Genius sessions, however, Seidle highlighted the importance of removing structures that create the illusion of credentials. After expanding the SparkFun office to include a second floor, SparkFun employees immediately began to call themselves "carpet walkers" or "cement walkers," referring to the different types of flooring on the two levels. In addition to making his workers less spatially proximate to one another, Seidle realized that the company had inadvertently created separate "classes" of employees, who were perhaps less likely to collaborate. If firms hope to facilitate boundary jumping, Seidle underscored that it is important to be aware of the hierarchies, apparent and unapparent, that might be barriers to productive interactions.

Related to the concept of removing labels or credentials, which can inhibit imagination based upon assumptions and expectations, is the idea that boundary jumping is facilitated by creating *generative* structures. *Generativity,* as the term is used by Professor Jonathan Zittrain, refers to any technology that allows users to make new things. Generative devices invite user innovations and

production that the designer of the generative device never intended or imagined.[22] Zittrain argues that generative products are good for society because they provide tools for humans to innovate.

SparkFun, recognizing the value of generative platforms, no longer labels its products as having certain "uses." This arose from an unexpected experience. SparkFun initially labeled one of its circuit boards as being capable of "measuring tilt." Later SparkFun learned that a group of medical researchers at Mt. Sinai was using their product to measure gait in patients with limps. It had never occurred to SparkFun that medical researchers would use the product nor that it would be used to measure gait. After recognizing that Sparkfun may be inhibiting other boundary jumping innovations from unexpected uses, the company stopped labeling products for specified uses. By not limiting the potential uses of SparkFun products, they become generative tools that are applicable in a limitless number of disciplines, making them tools that easily facilitate boundary jumping.

D. Cross-Industry Social Networks

Entrepreneurs can often become overly entrenched in their own business, industry, and routine ways of thinking. This makes entrepreneurs more spatially distant from other industries, which can be a barrier to innovation. One relatively simple way for individuals to avoid becoming siloed in their own experience is to form or join cross-industry social networks. By moving outside of one's own industry, individuals are better able to expand both their spatial and cognitive proximity as well as their absorptive capacities. Roundtable participants, Matt Cutter of Upslope Brewing and Don Martin, founder and CEO of Bloomin', belong to a cross-industry group of CEOs called the Insomniacs. The Insomniacs group is comprised of CEOs from diverse industries who meet regularly with the aim of disrupting one another's standard ways of thinking. The group shares ideas for business methods and practices, financial models, market opportunities, and more. By convening, these CEOs learn about other industries, expanding their cognitive proximities and making them better able to identify innovative solutions in their businesses.

It was noted by Martin however, that these social networks lose their usefulness if the distances between the businesses are too great. While the Insomniacs group is diverse, it is limited to businesses that make over one million dollars in revenues and that are in the consumer products space. At some point, Martin felt that the cognitive distances between industries would make interaction unhelpful and that the knowledge gained could not be effectively put to use in novel ways.

The structures discussed above are useful in creating more spatial proximity between individuals, industries, and intellectual disciplines. However, productive boundary jumping also requires cognitive proximity. Although the structures explored above can also help bridge cognitive distances, the skills and processes that follow are key to expanding cognitive proximity and absorptive capacity.

Part III. Skills Necessary to Facilitate Boundary Jumping

An individual's absorptive capacity and ability to understand and communicate with others is framed by physical, social, and institutional environments. An important insight from the

[22] Jonathan Zittrain, The Future of the Internet and How to Stop It (2008).

Roundtable, significantly, is that an individual's absorptive capacity is not fixed. Rather, Roundtable participant Devon Tivona opined that there are skills that can be learned, practiced, and honed that can expand an individuals absorptive capacity or bridge their cognitive distance from others. This has educational implications. The fact that these skills and capabilities are not fixed quantities is also important when considering the age of specialization in which we live today. An individual's ability to foster these skills will be increasingly important as we become more and more specialized and therein cognitively distant from one another.

A. Processes for Cognitive Proximity: Acquisition, Capture, and Retrieval of Good Ideas

Researcher Andrew Hargadon refers to those who boundary jump as *technology brokers*: those who have learned to "bridge the disparate worlds they move among outside their boundaries . . . building new ventures from technologies and people they come across."[23] Put another way, these technology brokers have learned to bridge the cognitive distances between themselves and other disciplines. Hargadon has studied the design firm IDEO, discussed in Part I *supra*, in order to gain insight into how technology brokers bridge these cognitive distances. The processes used by IDEO engineers suggest that in order to bridge disparate worlds, those who boundary jump must have some sort of internal or external mechanism to: (1) capture good ideas, (2) keep those good ideas alive, and (3) put promising concepts and ideas to the test in novel ways.[24] Ideas that are shared during a boundary jumping interaction will not lead to new innovations if the parties involved do not have a the organizational memory to acquire, retain, and retrieve the new combinations of information that they have obtained through boundary jumping.[25] By implementing these processes, an individual is able to bridge the cognitive distances between himself and others, allowing for the productive exchange of ideas that would otherwise be too unfamiliar to use. Notably, acquisition, retention, and retrieval of ideas are necessary skills in boundary jumping that do not exist in a vacuum. They can be bolstered and enhanced by training and practice.

B. Design Thinking and Empathy Based Problem Solving

Design thinking is a repeatable, iterative problem solving protocol that emphasizes the importance of human-centered observation and empathy. Design thinking teaches that individuals must first meaningfully observe the world outside of one's own domain and then translate that observation through empathy (the effort to see the world through the eyes of others) into innovations that will improve the status quo.[26] By emphasizing human-centered empathy, design thinking helps individuals to expand their cognitive absorptive capacities. As such, it has been at the center of how boundary jumping firms think about problem solving.

The three phases of design thinking can be conceptualized as *inspiration, ideation,* and *implementation*. Each of these rely deeply upon empathy. Empathy that makes design thinking a powerful tool to facilitate boundary jumping. By attempting to see the world through the eyes of others, we are able to expand our cognitive proximity to others, making boundary jumping more

[23] Andrew Hargadon, *The Best Practices of Technology Brokers*, HBS Working Knowledge Archives, Aug. 4, 2003, *available at* http://hbswk.hbs.edu/archive/3613.html.
[24] Andrew Hargadon, *The Best Practices of Technology Brokers*, HBS Working Knowledge Archives, Aug. 4, 2003, *available at* http://hbswk.hbs.edu/archive/3613.html.
[25] Andrew Hargadon & Robert I. Sutton, *Technology Brokering and Innovation in a Product Development Firm*, 42 ADMIN. SCIENCE QUARTERLY 716, 717 (1997).
[26] Tim Brown, Change By Design: How Design Thinking Transforms Organizations and Inspires Innovation 49 (2009).

likely to occur. As such, design thinking is a technique that organizations or individuals should consider practicing if they wish to facilitate boundary jumping innovations.

C. "T-Shaped Individuals"

An individual must be comfortable in interdisciplinary environments to excel in boundary jumping innovations. McKinsey & Company identifies these people – those who excel at boundary jumping – as being "t-shaped."[27] On the vertical axis, they possess a core competency or deep expertise that allows them to substantively contribute to certain types of problems. This can be, for example, an expertise in computer science, botany, or architecture. On the horizontal axis, the t-shaped individual has a cultural range that gives them a disposition for collaboration across disciplines. This takes them from being "multidisciplinary...to truly interdisciplinary."[28] This second axis, which makes the individual capable of collaborating across disciplines, is where individuals have been able to expand their cognitive proximity to others. They have learned techniques or communication skills that have made them capable of empathizing and thereby understanding concepts that are foreign to them.

Both the design firm IDEO and the Stanford d.school spend significant time finding and cultivating this horizontal axis in individuals. Having t-shaped individuals at IDEO is of particular importance because IDEO engineers engage in boundary jumping every day. Although they may be industrial designers or architects by training, IDEO engineers do not apply their skills in any one industry. Hence, they must have the ability to collaborate with and produce innovations for diverse clients ranging from financial institutions to consumer products companies like Coca-Cola to the Centers for Disease Control. IDEO CEO Tim Brown states that this type of radical boundary jumping is only possible when everyone in his organization is t-shaped.

An important dimension to boundary jumping that relates to the concept of the t-shaped individual is cultural range. Roundtable participant Eva Yao, a Professor of Management and Entrepreneurship at the University of Colorado and an expatriate from China, suggested that the promise of boundary jumping is often limited because certain groups of people are rarely brought into the boundary jumping interaction. In Eva's experience, boundary jumping interactions often exclude women, immigrants, and racial minorities. Because these groups have unique perspectives, boundary jumping innovations are limited without them. Hence, to optimize innovation, organizations need to be mindful to both cultivate the t-shaped individual and ensure they are interacting with a sufficiently diverse range of constituencies.

Related to the concept of t-shaped individuals, and perhaps a characteristic that many t-shaped individuals exhibit, is an ability to be comfortable and excel in situations of uncertainty or those that lack structure. If environments of modest anarchy facilitate the most innovation, then individuals must be able to function within those environments.

One way of thinking about this skill is confidence. Specifically, a person who can successfully boundary jump must be sufficiently confident in their own capabilities and experience that they are comfortable moving beyond that experience to explore new domains. Hargadon has

[27] Tim Brown, Change By Design: How Design Thinking Transforms Organizations and Inspires Innovation 27 (2009).
[28] Tim Brown, Change By Design: How Design Thinking Transforms Organizations and Inspires Innovation 27 (2009).

termed this creative confidence as an "attitude of wisdom."[29] Those with an "attitude of wisdom" are able to bridge cognitive distances between themselves and others because "they are neither too arrogant nor too insecure to ask others for help and because they treat what they know with humility and what others know with respect."[30] Hence, an "attitude of wisdom" gives individuals the skills to interact with others in ways that reduce the cognitive distances between them. As such, it is a skill that facilitates boundary jumping.

D. Observational Skills and Associational Thinking

Boundary jumping innovations occur when pre-existing knowledge is combined in novel ways. Hence, the ability to look at problems and observe the world in nonstandard ways is a skill that facilitates boundary jumping. However, these observational skills must also be paired with what researchers refer to as associational thinking. Associational thinking is a skill that allows individuals to associate ideas that are previously unconnected to create something new.[31]

Roundtable participant John Goldsmith, an independent investor, suggested that observational skills could be fostered by cultivating an awareness that solutions likely exist in other domains. Tom Kelley, the founder of IDEO refers to these deep observational skills as "vuja de:" the ability to observe items we have seen so many times we fail to notice them. More specifically, Kelley argues that innovations occur when individuals learn to observe the novel in the everyday.

For example, this could include an ability to look beyond the common uses of products. Such observations and associations were made by Jorge Odon, an Argentinean car mechanic, after he watched a video on YouTube of a cork being extracted from a wine bottle using nothing but a plastic bag. Odon realized that a similar technique might be used remove a baby stuck in the birthing canal. Although it seems unlikely that a mechanic would invent a new birthing technique based on a party trick, Odon's technique has received praise from the World Health Organization and has been licensed by an American medical company.[32]

Part IV. Conclusion

Although many businesses might seek to innovate by looking outside of their own industries, boundary jumping requires more than a decision to collaborate with others. Boundary jumping innovations require both spatial and cognitive proximity between the firms, industries, or individuals interacting across boundaries. Fortunately, spatial and cognitive proximities are not fixed quantities. Rather, they can be fostered and expanded through the architecting of certain structures and the cultivation of certain skills.

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[29] Andrew Hargadon & Robert I. Sutton, *Technology Brokering and Innovation in a Product Development Firm*, 42 ADMIN. SCIENCE QUARTERLY 716, 742 (1997).
[30] Id.
[31] Farnam Street, *Five Skills of Disruptive Innovators*, Businessinsider.com, http://www.businessinsider.com/5-skills-of-disruptive-innovators-2013-12?nr_email_referer=1&utm_source=Triggermail&utm_medium=email&utm_term=Business%20Insider%20Select&utm_campaign=BI%20Select%20Mondays%202013-12-09&utm_content=emailshare.
[32] Donald G. McNeil, *Car Mechanic Dreams Up Tool to Ease Births,* NYTimes.com (Nov. 13, 2013) http://www.nytimes.com/2013/11/14/health/new-tool-to-ease-difficult-births-a-plastic-bag.html?_r=0.

Understanding these structures and skills is important for facilitating boundary jumping but will become increasingly crucial in industries where hyperspecialization occurs. Although hyperspecialization is a useful model for the efficient division of labor, it tends to increase the spatial and cognitive distances between individuals, making boundary jumping less likely to occur. Therefore, it will be important that businesses and individuals pay special attention to boundary jumping if game-changing boundary jumping innovations are to continue.

Appendix A
List of Roundtable Participants

Toma Bedolla, Co-founder, House of Genius
Brad Bernthal, Associate Professor of Law, Colorado Law
Charisse Bowen, Director, Institute of Entrepreneurship, Colorado State University
Hanna Boyd, Senior, Finance, Entrepreneurship and Digital Art, University of Colorado at Boulder
Matt Cutter, Founder, Upslope Brewing Company
Jim Deters, Co-Founder and CEO, Galvanize
Dave DuPont, President and CEO, TeamSnap
Bret Fund, Assistant Professor of Management and Entrepreneurship,
University of Colorado at Boulder
Alicia Gibb, Executive Director, Open Source Hardware Association
John Goldsmith, Independent Investor
Trish Groom, VP of Sales and Founder, Splick-it
Clif Harald, Executive Director, Boulder Economic Council
Kirk Holland, Managing Director, Access Venture Partners
Lane Hornung, CEO and Founder, 8z Real Estate
Peter Johnson, Networking Czar, Van Heyst Group, Inc. and Co-Founder, Startup Phenomenon
Matthew Kaufman, Partner, Hathaway & Kunz, P.C.
Don R. Martin, President, Bloomin
Monisha Merchant, Sr. Advisor for Business Affairs, Office of U.S. Senator Michael Bennet
Mystery Murphy, Research Fellow, Silicon Flatirons Center
Anna Noschese, Program Director, Silicon Flatirons Center
Anthony Santopolo, Entrepreneurial Law LLM Student, Colorado Law
Carrie Schiff, Partner, Sage Law Group
Jamie Schuster, Second Year Law Student, Colorado Law
Eric Schweikardt, CEO and Design Director, Modular Robotics
Nathan Seidle, Founder and CEO, SparkFun Electronics
Devon Tivona, Senior, Computer Science, University of Colorado at Boulder and Student
Consultant, Leeds School of Business
Eva Yao, Assistant Professor of Management and Entrepreneurship,
University of Colorado at Boulder

The new dynamics of strategy: Sense-making in a complex and complicated world

by C. F. Kurtz
D. J. Snowden

In this paper, we challenge the universality of three basic assumptions prevalent in organizational decision support and strategy: assumptions of order, of rational choice, and of intent. We describe the Cynefin framework, a sense-making device we have developed to help people make sense of the complexities made visible by the relaxation of these assumptions. The Cynefin framework is derived from several years of action research into the use of narrative and complexity theory in organizational knowledge exchange, decision-making, strategy, and policy-making. The framework is explained, its conceptual underpinnings are outlined, and its use in group sense-making and discourse is described. Finally, the consequences of relaxing the three basic assumptions, using the Cynefin framework as a mechanism, are considered.

Over the past several years, our group has been conducting a program of disruptive action research using the methods of narrative and complexity theory to address critical business issues.[1] Action research has been defined as grounding theory in contextual exploration, emphasizing participation, and embracing change.

We started work in the areas of knowledge management, cultural change and community dynamics, then expanded into product development, market creation and branding, and in recent years have been working increasingly in the area of national and organizational strategy. Some of this work has been directly funded by the U.S. government through DARPA (Defense Advanced Research Project Agency) as well as by other government agencies (in particular in Singapore) which are interested in new approaches to supporting policy-making. The central element of our approach is the Cynefin framework for sense-making. In this paper we describe the framework and its conceptual basis, and we detail some of its uses for sense-making to support decision-making in varied dynamical contexts.

Conceptual approach. We begin by questioning the universality of three basic assumptions that pervade the practice and to a lesser degree the theory of decision-making and policy formulation in organizations. These are:

The assumption of order: that there are underlying relationships between cause and effect in human interactions and markets, which are capable of discovery and empirical verification. In consequence, it is possible to produce prescriptive and predictive models and design interventions that allow us to achieve goals. This implies that an understanding of the causal links in past behavior allows us to define "best practice" for future behavior. It also implies that there must be a right or ideal way of doing things.

The assumption of rational choice: that faced with a choice between one or more alternatives, human ac-

tors will make a "rational" decision based only on minimizing pain or maximizing pleasure; and, in consequence, their individual and collective behavior can be managed by manipulation of pain or pleasure outcomes and through education to make those consequences evident.

The assumption of intentional capability: that the acquisition of capability indicates an intention to use that capability, and that actions from competitors, populations, nation states, communities, or whatever collective identity is under consideration are the result of intentional behavior. In effect, we assume that every "blink" we see is a "wink," and act accordingly. We accept that we do things by accident, but assume that others do things deliberately.

This paper contends that although these assumptions are true within some contexts, they are not universally true. We also believe that in decision-making at both policy-making and operational levels, we are increasingly coming to deal with situations where these assumptions are not true, but the tools and techniques which are commonly available assume that they are.

Order and chaos in antiquity. The human distinction between order and chaos goes back to an abundant presence in mythology, in which order arises out of (and thus requires) and then vanquishes (and thus destroys) the mysterious forces of chaos. For example, in the Enuma Elish,[2] the Babylonian epic of creation, the world began under the reign of Tiamat, the mother of all things. In Tiamat's world, "none bore a name, and no destinies were ordained." After several generations, Tiamat's god-children appointed a champion to seize control. Marduk not only defeated his ancestor, but "split her up like a flat fish into two halves" that became heaven and earth. He then proceeded to order the universe in finer and finer detail:

> He [Marduk] made the stations for the great gods;
> The stars, their images, as the stars of the Zodiac, he fixed.
> He ordained the year and into sections he divided it;
> For the twelve months he fixed three stars. . . .
> He founded the station of Nibir [the planet Jupiter] to determine their bounds;
> That none might err or go astray . . .

Note the words "fixed," "ordained," "divided," "determined," "err," and "astray." Control (in the first four terms) and an absolute knowledge of right and wrong (in the last two) are the salient points of Marduk's new world. Of course Tiamat was never entirely vanquished; forces of chaos appear in all traditions in the form of tricksters and malcontents such as Bacchus, Loki, Coyote, the Monkey King, Anansi, and Hermes. The forces of order and chaos danced with each other throughout ancient times.

Science, order, and epiphenomena. Aristotle defined four types of cause: the material (what you are made of, your muscles and organs), the efficient (how you came to be, the fact that your parents gave birth to you), the formal (your type, your species), and the final (your function, your life itself, your place in the universe). He believed that to understand an event or entity, one had to consider all of these factors in the particular, the mysterious as well as the ordered. As others have pointed out,[3] the focus of Western thinking post Kant on efficient cause only is to the detriment of knowledge.

Since the birth of enlightenment science, the distinction between order and chaos has held a prominence that has profoundly influenced conceptual and practical thinking. Kant separated things that we can know empirically from things that are the province of God, and thereby helped to section off all but efficient causes to epiphenomena that could be safely ignored. This concept of ordered science triggered a massive growth in human knowledge and extended over many disciplines. For example, sociology grew out of philosophy partly in an attempt to create a "science of society" that could duplicate the advances being made in physics and biology through systematic observation and causal explanation. It was argued, mainly by Comte, that it was theoretically possible to discover laws similar to those of physics which could explain the behavior of people in societies. The growth of technology and the dominance of engineering-based approaches arising from the need for automation and scalability reenforced the desire for and the assumption of order. In popular literature, the belief that all things can be known (in a Newtonian sense) persisted well into this past century. Asimov's classic science fiction *Foundation Trilogy*[4] builds on the character of Hari Seldon, the founder of psychohistory, whose mathematics permits the prediction of human behavior and social change centuries into the future.

The development of management science, from stopwatch-carrying Taylorists[5] to business process reengineering, was rooted in the belief that systems were

ordered; it was just a matter of time and resources before the relationships between cause and effect could be discovered.[6] The case study approach of many M.B.A. programs and the desire for precise recommendations from policy teams and external consultants perpetuate the underlying assumption of universal order. Good leadership is linked to certain competences that (it is claimed) can be mapped and identified, and then replicated. The desire for order can even lead people to accept completely abhorrent working conditions and political structures simply to avoid "chaos" (a tendency exploited by dictators from Pisistratus to Hitler and beyond). All of these approaches and perceptions do not accept that there are situations in which the lack of order is not a matter of poor investigation, inadequate resources, or lack of understanding, but is a priori the case—and not necessarily a bad thing, either.

Complexity science. A new awareness of the ancient counterpart to order began over a century ago with Poincaré and several others, and has surged in recent decades.[7–10] In fact there is a fascinating kind of order in which no director or designer is in control but which emerges through the interaction of many entities. Emergent order has been found in many natural phenomena: bird-flocking behavior can be simulated on a computer through three simple rules [11]; termites produce elegant nests through the operation of simple behaviors triggered by chemical traces[12]; each snowflake is a unique pattern arising from the interactions of water particles during freezing.[13] The patterns that form are not controlled by a directing intelligence; they are self-organizing.[14] The new science of complexity spawned by these findings is interdisciplinary, touching fields from mathematics to evolution to economics to meteorology to telecommunications.[15] In the domain of emergent order, the goal "to predict (and thereby control) the behavior of systems not yet studied (but similar to those that have been studied) under conditions not yet extant and in time periods not yet experienced"[16] is difficult if not impossible to achieve—but other goals are achievable.

Awareness of emergent order has as yet had comparatively little influence on mainstream theory and practice in management and strategy, though some authors have been exploring these topics with some success.[17–21] We are sorry to say that in our opinion too many of the books written for a popular business audience on the subject have been marred by misunderstandings, misapplications, and most of all misplaced zeal (some even falling into pseudo-scientific and pseudo-religious thinking). Our group has been using ideas based on complexity science in our action research work for the past several years, and the work we will describe here benefits from that influence.

Contextual complexity. A considerable amount of research and some early practice is taking place using complex system principles, mainly using computing power to simulate natural phenomena through agent-based models.[12] Well-known examples include routing optimization of airfreight and telecommunication signals based on large volume data modeling in which each agent is programmed to operate on simple rules, the result of which is the emergence of complex patterns of behavior.[22] We believe that such tools are valuable in certain contexts, but are of more limited applicability when it comes to managing people and knowledge. There are at least three important contextual differences between human organizations and those of ant colonies that make it more difficult to simulate them using computer models. In a sense, because we have not seen these issues addressed as fully as we would like, we put them forth as challenges to agent-based simulation of human behavior.

Humans are not limited to one identity. In a human complex system, an agent is anything that has identity, and we constantly flex our identities both individually and collectively. Individually, we can be a parent, sibling, spouse, or child and will behave differently depending on the context. Collectively, we might, for example, be part of a dissenting community, but in the face of a common threat, we might assume the identity of the wider group. Accordingly, it is not always possible to know which unit of analysis we are working with.

There are generally three solutions to this problem of the unit of analysis in the social simulation literature.[23] First, individuals are modeled and group behavior is explained by the concept of "norms."[24] But identity goes deeper than norms—it determines not only reactions but perceptions and patternings of experience. A second solution is to model groups as agents, but much internal diversity and patterning is suppressed in this approach. It also makes assumptions about intent and predictability that are difficult to sustain. The third solution to the unit-of-analysis problem is to consider the rule or idea or "meme" as the unit of analysis,[25] but again we find that insufficient to capture the dynamics of multiple identities. We would like (but do not expect) to see sim-

ulations of human behavior able to encompass multiple dynamic individual and collective identities acting simultaneously and representing all aspects of perception, decision-making, and action.

Humans are not limited to acting in accordance with predetermined rules. We are able to impose structure on our interactions (or disrupt it) as a result of collective agreement or individual acts of free will.

We are capable of shifting a system from complexity to order and maintaining it there in such a way that it becomes predictable.

We are capable of shifting a system from complexity to order and maintaining it there in such a way that it becomes predictable. As a result, questions of intentionality play a large role in human patterns of complexity.[3] It is difficult to simulate true free will and complex intentionality (for example, retrospective elaboration, duplicity, groupthink, rumor, self-deception, manipulation, surprise, confusion, internal conflict, stress, changes in the meanings of previously unambiguous messages, the deliberate creation of ambiguity, inadvertent disclosure, charisma, cults, and pathologies) within a rule-based simulation. Social simulations have addressed issues such as cooperation, reputation, gossip, lying, and trust,[26] but always within an artificial framework which allows only limited numbers of options and considers limited numbers of phenomena operating at once. It is interesting that searching the Internet for "simulation" and most of the terms listed above brings up instances of simulations with which a user interacts to explore patterns.[27] This may represent a gap between agent-based simulation and human behavior similar to that found by the "strong artificial intelligence (AI)" school of the 1970's whose goal was to reproduce human intelligence.[28] We do not mean to say that there is no value to simulation of human behavior, but we do think we should not expect it to succeed any time soon in predicting what people will do in any particular circumstance.

Eventually the concept of "intelligent augmentation"[29–30] grew in popularity and could be said to bridge the gap between strong AI and reality. It is possible that a middle ground between the belief that all human behavior can be simulated and the belief that the very effort is questionable will be found in the use of simulation not to explain or imitate but to support human decision-making.

Humans are not limited to acting on local patterns. People have a high capacity for awareness of large-scale patterns because of their ability to communicate abstract concepts through language, and, more recently, because of the social and technological infrastructure that enables them to respond immediately to events half a world away. This means that to simulate human interaction, all scales of awareness must be considered simultaneously rather than choosing one circle of influence for each agent. There is also the matter of simulating the interaction (conflict, reinforcement) between local and global awareness. Many of the emergent patterns we see in nature depend critically on the limited (that is, local) ability of activators to diffuse through a viscous medium.[13] We have not yet seen addressed how these issues cause complex patterns in human societies to differ from complex patterns in systems of locally aware agents.

We call our practice of keeping the human context foremost in our considerations phenomenological or more commonly "contextual complexity." It means mainly that when we use agent-based simulation (and we do, in certain circumstances), we use it as a tool for the exploration of possibility and generation of ideas, not as a tool for recommending courses of action.

Order and un-order. To avoid much repetition of the longer terms "directed order" and "emergent order," we call emergent order "un-order." Un-order is not the lack of order, but a different kind of order, one not often considered but just as legitimate in its own way. Here we deliberately use the prefix "un-" not in its standard sense as "opposite of" but in the less common sense of conveying a paradox, connoting two things that are different but in another sense the same. Bram Stoker used this meaning to great effect in 1897 with the word "undead," which means neither dead nor alive but something similar to both and different from both. According to R. D. Cureton, e. e. cummings also used the prefix this way in his poetry. Says Cureton,[31] "In normal usage, being and existing are stative concepts. They are not actions which a person must consciously perform, engage in, create. Words such as unbe and unexist, however, force the reader to see the dynamic nature of human existence. . . ." Thus by our use of the term

"un-order," we challenge the assumption that any order not directed or designed is invalid or unimportant.

Keep the baby, lose the bathwater. Let us sound a quick warning about running into the trap of believing that everything is complex. Some recent popular books on complexity in business and management have been full of breathy enthusiasm for the "edge of chaos" and would have businesses maintain themselves as far from equilibrium as possible, regardless of context or purpose. We think this is throwing out the baby with the bathwater. We cannot simply go from saying "things are ordered" to saying "things are un-ordered" and leave it at that; things are both ordered and un-ordered at once, because in reality order and un-order intertwine and interact. Kostof[32] puts it well in his description of cities: ". . . the two primary versions of urban arrangement, the planned and the 'organic,' often exist side by side. . . . Most historic towns, and virtually all those of metropolitan size, are puzzles of premeditated and spontaneous segments, variously interlocked or juxtaposed. . . ." In other words, it is useful to artificially separate order and un-order so that we can understand the different dynamics involved, but we should not expect to find one without the other in real life. In many organizations, for example, formal command structures and informal trust networks support (while simultaneously competing with) each other.[33–34] The joke that "the only thing worse than an inefficient bureaucracy is an efficient bureaucracy" has some ground in reality.

Methods for un-ordered space

Ordered-systems thinking assumes that through the study of physical conditions, we can derive or discover general rules or hypotheses that can be empirically verified and that create a body of reliable knowledge, which can then be developed and expanded. As we have mentioned, this assumption does not hold in the domain of un-order.

In practice, all decision makers know this: however much they might like things to be ordered, they know that there are also circumstances in which "cultural factors," "inspired leadership," "gut feel," and other complex factors are dominant. All of these are patterns, which arise through the interaction of various entities through space and time. In the space of un-order the seeds of such patterns can be perceived, and new ways of thinking can emerge. In fact, learning to recognize and appreciate the domain of un-order is liberating, because we can stop applying methods designed for order and instead focus on legitimate methods that work well in un-ordered situations. Tom Stewart[35] references the case of a group of marines taken to the New York Mercantile Exchange in 1995 to be taught and to play with simulators of the trading environment. Naturally the traders won each time. But when the traders visited the Marine Corp's base in Quantico and played war games against the marines, they won yet again. What they realized is that the traders were skilled at spotting patterns and intervening to structure those patterns in their favor. The Marines, on the other hand, like most business school graduates, had been trained to collect and analyze data and then make rational decisions. In a dynamic and constantly changing environment, it is possible to pattern un-order but not to assume order.

In another case, a group of West Point graduates were asked to manage the playtime of a kindergarten as a final year assignment. The cruel thing is that they were given time to prepare. They planned; they rationally identified objectives; they determined backup and response plans. They then tried to "order" children's play based on rational design principles, and, in consequence, achieved chaos. They then observed what teachers do. Experienced teachers allow a degree of freedom at the start of the session, then intervene to stabilize desirable patterns and destabilize undesirable ones; and, when they are very clever, they seed the space so that the patterns they want are more likely to emerge.

In the ordered domain we focus on efficiency because the nature of systems is such that they are amenable to reductionist approaches to problem solving; the whole is the sum of the parts, and we achieve optimization of the system by optimization of the parts. In the domain of un-order, the whole is never the sum of the parts; every intervention is also a diagnostic, and every diagnostic an intervention; any act changes the nature of the system. As a result, we have to allow a degree of sub-optimal behavior of each of the components if the whole is to be optimized.

Pattern entrainment

Humans use patterns to order the world and make sense of things in complex situations. Give a child a pile of blocks, and he or she will build patterns out of them. Give an adult a daily commute, and he or she will build patterns within it. Patterns are some-

thing we actively, not passively, create, as Mary Douglas[36] so well pointed out:

> . . . whatever we perceive is organized into patterns for which we the perceivers are largely responsible. . . . As perceivers we select from all the stimuli falling on our senses only those which interest us, and our interests are governed by a pattern-making tendency, sometimes called a schema. In a chaos of shifting impressions, each of us constructs a stable world in which objects have recognizable shapes, are located in depth and have permanence. . . . As time goes on and experience builds up, we make greater investment in our systems of labels. So a conservative bias is built in. It gives us confidence.

Visually, we hold in sharp focus at any one instant a mere tenth of a percent of our visual range, so even the process of seeing is one of putting together many disparate observations.[37] We fill in the gaps to create an experience-based pattern on which we act. This aspect of human decision-making is a great source of power, but it also brings limitation.

A television advertisement for a liberal broadsheet newspaper in the United Kingdom illustrates this well. The advertisement is set in a terraced inner city street. It is dusk; litter blows down the street; overall, a threatening environment.

> *Scene One*: The camera points down the street and picks up a skinhead who comes around the corner. A police car stops beside the skinhead, who immediately runs towards the camera. Pattern entrainment of decision-making: what do we assume? The skinhead must be running from the police.
>
> *Scene Two*: The camera now changes its perspective; it is now behind the skinhead, and we see that he is running towards a well dressed man who is clutching a briefcase—which must be full of money, as the man conforms to the stereotype of a rent collector. We can also see that the man is terrified in the face of the rapidly approaching skinhead. Pattern entrainment of decision making: what do we assume? The man is going to be mugged.
>
> *Scene Three*: The camera changes perspective for the final time; we are now looking down on the street from above, and we see the skinhead grab the man and pull him into the portico of a building just before a crate of building material would have fallen on his head and killed him.

The unspoken message of a brilliant advertisement is, "See things from a different perspective; read the newspaper."

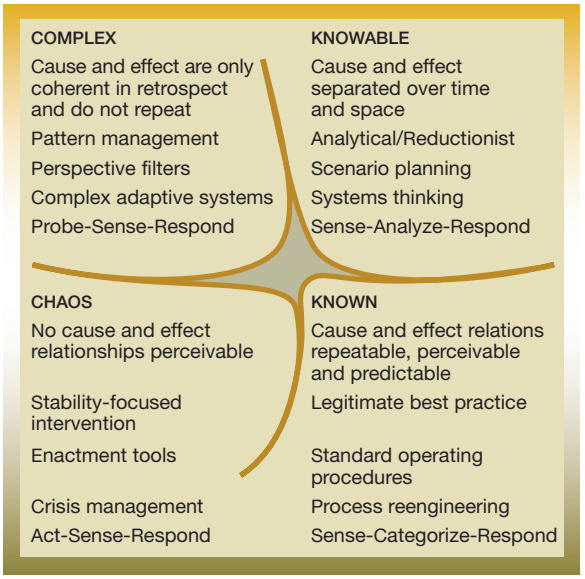
Most of the time if you are standing in a run-down inner city area at dusk carrying a briefcase full of money, and a skinhead suddenly runs towards you, it is not a good idea to stand there and say "Ah, I may be about to be rescued from a crate of falling building material"; you should run for your life. The issue in decision-making is to know when to run and when to stand still. A choice must be made between allowing the entrained patterns of past experience to facilitate fast and effective pattern application and gaining a new perspective because the old patterns may no longer apply. We will address these differences in the following section.

The Cynefin framework

The name *Cynefin* is a Welsh word whose literal translation into English as habitat or place fails to do it justice. It is more properly understood as the place of our multiple affiliations, the sense that we all, individually and collectively, have many roots, cultural, religious, geographic, tribal, and so forth. We can never be fully aware of the nature of those affiliations, but they profoundly influence what we are. The name seeks to remind us that all human interactions are strongly influenced and frequently determined by the patterns of our multiple experiences, both through the direct influence of personal experience and through collective experience expressed as stories.

The Cynefin framework originated in the practice of knowledge management as a means of distinguishing between formal and informal communities, and as a means of talking about the interaction of both with structured processes and uncertain conditions. It has now outgrown its application in knowledge management, having been in use by our group for several years in consultancy and action research in knowledge management, strategy, management, training, cultural change, policy-making, product development, market creation, and branding. We are now beginning to apply it to the areas of leadership, customer relationship management, and supply chain management, with other topics to come. It has also been used by third parties.[38]

Figure 1 Cynefin domains



We consider Cynefin a *sense-making* framework, which means that its value is not so much in logical arguments or empirical verifications as in its effect on the sense-making and decision-making capabilities of those who use it. We have found that it gives decision makers powerful new constructs that they can use to make sense of a wide range of unspecified problems. It also helps people to break out of old ways of thinking and to consider intractable problems in new ways. The framework is particularly useful in collective sense-making, in that it is designed to allow shared understandings to emerge through the multiple discourses of the decision-making group.

We make a strong distinction here between sense-making frameworks and *categorization* frameworks. In a categorization framework, four quadrants are often presented in a two-by-two matrix (for examples, pick up any management textbook or analyst report). Typically, it is clear (though often unstated) that the most desirable situation is to be found in the upper right-hand quadrant, so the real value of such a framework is to figure out how to get to the upper right. In contrast, none of the domains we will describe here is more desirable than any other; there are no implied value axes. Instead, the framework is used primarily to consider the dynamics of situations, decisions, perspectives, conflicts, and changes in order to come to a consensus for decision-making under uncertainty.

As can be seen in Figure 1, the Cynefin framework has five domains, four of which are named, and a fifth central area, which is the domain of disorder. The right-hand domains are those of order, and the left-hand domains those of un-order.

Ordered domain: Known causes and effects. Here, cause and effect relationships are generally linear, empirical in nature, and not open to dispute. Repeatability allows for predictive models to be created, and the objectivity is such that any reasonable person would accept the constraints of best practice. This is the domain of process reengineering, in which knowledge is captured and embedded in structured processes to ensure consistency. The focus is on efficiency. Single-point forecasting, field manuals, and operational procedures are legitimate and effective practices in this domain. Our decision model here is to sense incoming data, *categorize* that data, and then respond in accordance with predetermined practice. Structured techniques are not only desirable but mandatory in this space.

Ordered domain: Knowable causes and effects. While stable cause and effect relationships exist in this domain, they may not be fully known, or they may be known only by a limited group of people. In general, relationships are separated over time and space in chains that are difficult to fully understand. Everything in this domain is capable of movement to the known domain. The only issue is whether we can afford the time and resources to move from the knowable to the known; in general, we cannot and instead rely on expert opinion, which in turn creates a key dependency on trust between expert advisor and decision maker. This is the domain of systems thinking, the learning organization, and the adaptive enterprise, all of which are too often confused with complexity theory.[18] In the knowable domain, experiment, expert opinion, fact-finding, and scenario-planning are appropriate. This is the domain of methodology, which seeks to identify cause-effect relationships through the study of properties which appear to be associated with qualities. For systems in which the patterns are relatively stable, this is both legitimate and desirable.

Our decision model here is to sense incoming data, *analyze* that data, and then respond in accordance with expert advice or interpretation of that analysis. Structured techniques are desirable, but assumptions must be open to examination and challenge. This is the domain in which entrained patterns are at their most dangerous, as a simple error in an assumption

can lead to a false conclusion that is difficult to isolate and may not be seen.

It is important to note here that by known and knowable we do not refer to the knowledge of individuals. Rather, we refer to things that are known to society or the organization, whichever collective identity is of interest at the time. If I look up my organization's policy on travel to Iceland, I may not know what I will find there, or even how I will find it, but I know I can find something, because I know it is known to the organization. If I want to know how fish sleep, I may not know how or where to find out, but I have a hunch that somebody knows.

Un-ordered domain: Complex relationships. This is the domain of complexity theory, which studies how patterns emerge through the interaction of many agents. There are cause and effect relationships between the agents, but both the number of agents and the number of relationships defy categorization or analytic techniques. Emergent patterns can be perceived but not predicted; we call this phenomenon *retrospective coherence*. In this space, structured methods that seize upon such retrospectively coherent patterns and codify them into procedures will confront only new and different patterns for which they are ill prepared. Once a pattern has stabilized, its path appears logical, but it is only one of many that could have stabilized, each of which also would have appeared logical in retrospect. Patterns may indeed repeat for a time in this space, but we cannot be sure that they will continue to repeat, because the underlying sources of the patterns are not open to inspection (and observation of the system may itself disrupt the patterns). Thus, relying on expert opinions based on historically stable patterns of meaning will insufficiently prepare us to recognize and act upon unexpected patterns.

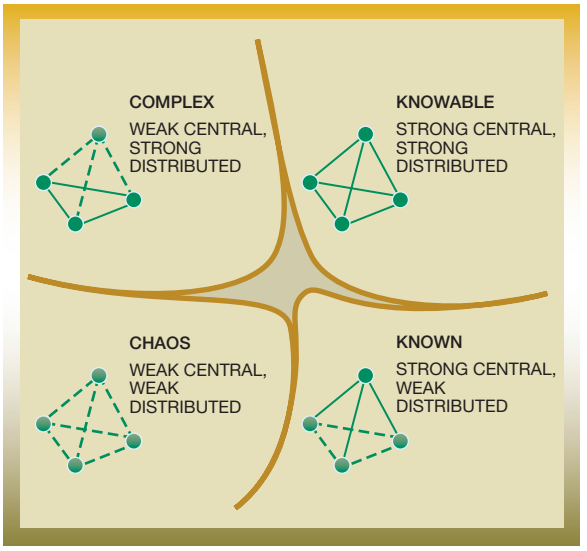
The decision model in this space is to create *probes* to make the patterns or potential patterns more visible before we take any action. We can then sense those patterns and respond by stabilizing those patterns that we find desirable, by destabilizing those we do not want, and by seeding the space so that patterns we want are more likely to emerge. Understanding this space requires us to gain *multiple perspectives* on the nature of the system. This is the time to "stand still" (but pay attention) and gain new perspective on the situation rather than "run for your life," relying on the entrained patterns of past experience to determine our response. The methods, tools, and techniques of the known and knowable domains do not work here. Narrative techniques are particularly powerful in this space. We have described elsewhere a range of methods designed to stimulate emergent patterns in complex knowledge interactions by increasing the number of perspectives available to a decision maker.[39]

Un-ordered domain: Chaos. In the first three domains we have described, there are visible relationships between cause and effect. In the chaotic domain there are no such perceivable relations, and the system is turbulent; we do not have the response time to investigate change.[8] Applying best practice is probably what precipitated chaos in the first place; there is nothing to analyze; and waiting for patterns to emerge is a waste of time. The chaotic domain is in a very real sense *uncanny*, in that there is a potential for order but few can see it—or if they can, they rarely do unless they have the courage to act. In known space it pays to be *canny*, that is, to know how to work the system in all its intricacies (canny meaning not only shrewd but safe). But in chaotic space, a canny ability gets you nowhere (there is no system to be worked). You need a different type of ability, one that is uncannily mysterious, sometimes even to its owner. Canny people tend to succeed in their own lifetimes; uncanny people tend to be recognized and appreciated only centuries later, because during their time their actions appeared to be either insane or pointless. Each of these styles has a unique ability to succeed in a particular space, and each is necessary.

The decision model in this space is to act, quickly and decisively, to reduce the turbulence; and then to sense immediately the reaction to that intervention so that we can respond accordingly. The trajectory of our intervention will differ according to the nature of the space. We may use an authoritarian intervention to control the space and make it knowable or known; or we may need to focus on multiple interventions to create new patterns and thereby move the situation into the complex space. Chaos is also a space we can enter into consciously, to open up new possibilities and to create the conditions for innovation.

The domain of disorder. The central domain of disorder is critical to understanding conflict among decision makers looking at the same situation from different points of view. Often in a group using the Cynefin framework, people agree on what the extremes of the four domains mean in the context they are considering, but disagree on more subtle differ-

Figure 2 Connection strength of Cynefin domains



ences near the center of the space. As a result, individuals compete to interpret the central space on the basis of their preference for action. Those most comfortable with stable order seek to create or enforce rules; experts seek to conduct research and accumulate data; politicians seek to increase the number and range of their contacts; and finally, the dictators, eager to take advantage of a chaotic situation, seek absolute control. The stronger the importance of the issue, the more people seem to pull it towards the domain where they feel most empowered by their individual capabilities and perspectives. We have found that the reduction in size of the domain of disorder as a consensual act of collaboration among decision makers is a significant step toward the achievement of consensus as to the nature of the situation and the most appropriate response.

The apple-orange problem

People are often confused by the apple-orange nature of the four Cynefin domains: they say, "Why not known, knowable, somewhat knowable and unknowable?" or, "Why not simple, complicated, complex and chaotic?" The distinction is intentional. The Cynefin framework is a phenomenological framework, meaning that what we care most about is how people perceive and make sense of situations in order to make decisions; perception and sense-making are fundamentally different in order versus unorder. The framework actually has two large domains, each with two smaller domains inside. In the right-side domain of order, the most important boundary for sense-making is that between what we can use immediately (what is known) and what we need to spend time and energy finding out about (what is knowable). In the left-side domain of unorder, distinctions of knowability are less important than distinctions of interaction; that is, distinctions between what we can pattern (what is complex) and what we need to stabilize in order for patterns to emerge (what is chaotic). Thus we often draw the framework with the vertical boundaries strong and the horizontal boundaries weak, denoting their relative importance in sense-making.

The Cynefin framework is based on three ontological states (namely, order, complexity and chaos) and a variety of epistemological options in all three of those states. We are currently engaged in further conceptual and experimental work to more strongly develop the separation of ontological from epistemological aspects of the framework in order to root the framework in a variety of scientific disciplines while maintaining the essential interweaving of ontology and epistemology, which appears to be an essential aspect of human sense-making in practice.

Connection strengths of Cynefin domains

Another way to look at the Cynefin framework is in the types of component connections that are most prevalent in each domain (Figure 2). On the side of order, connections between a central director and its constituents are strong, often in the form of structures that restrict behavior in some way—for example, procedures, forms, blueprints, expectations, or pheromones. On the side of un-order, central connections are weak, and attempts at control through structure often fail from lack of grasp or visibility. In the complex and knowable domains, connections among constituent components are strong, and stable group patterns can emerge and resist change through repeated interaction, as with chemical messages, acquaintanceship, mutual goals and experiences. The known and chaotic domains share the characteristic that connections among constituent components are weak, and emergent patterns do not form on their own.

In any of these domains, a reasonable strategy capitalizes on the stability afforded by strong connections without allowing them to harden so much that

they destroy flexibility and also capitalizes on the freedom and renewal afforded by weak connections without allowing them to permanently remove useful patterns.

How the Cynefin framework is used

In our engagements with clients, we use the Cynefin framework at several different levels, depending on the context and purpose of the project. Several complementary exercises and programs help people to internalize and make use of the framework. Some groups consider only the five domains and what sorts of situations or problems can be found there; some consider distinctions between extreme and equivocal conditions within domains; some consider multiple perspectives and how they can be resolved or used to advantage; some talk about boundary transitions, boundary sensing, and boundary management; some talk about dynamics ranging over the whole space of the framework. For example, groups might use the Cynefin framework to gain new insights on a contentious issue, plan interventions to move a situation from one domain to another, consider how they should approach or manage different formal and informal communities, or differentiate their strategies for knowledge retention based on multiple contexts of knowledge exchange.

Contextualization. This is a critical exercise that enters into nearly every Cynefin project. Contextualization is also a good example of how the Cynefin framework concentrates on collective sense-making as a consequence of discourse. We will describe a typical contextualization session here. The session begins with the collection of many items through structured brainstorming. The items might be communities, products, actions, motivations, forces, events, points of view, beliefs, traditions, rituals, books, metaphors, anecdotes, myths, and so on: they are any items that are important to the sense-making process. The items are related to one theme or issue of concern, which should be broad but not infinitely so. Whatever sorts of items are chosen (and multiple types are permissible), they should be diverse and concrete in nature: diverse to allow multiple perspectives to emerge, and concrete to move away from existing entrained abstract beliefs. We assure diversity by giving different groups of people different directions, by giving directions that are deliberately ambiguous and so can be taken in diverse ways, and by changing group compositions frequently so that people do not fall into entrained thinking. To keep items concrete, we rely heavily on narrative methods. These provide a rich context that allows patterns of experience rather than opinion or belief to emerge.

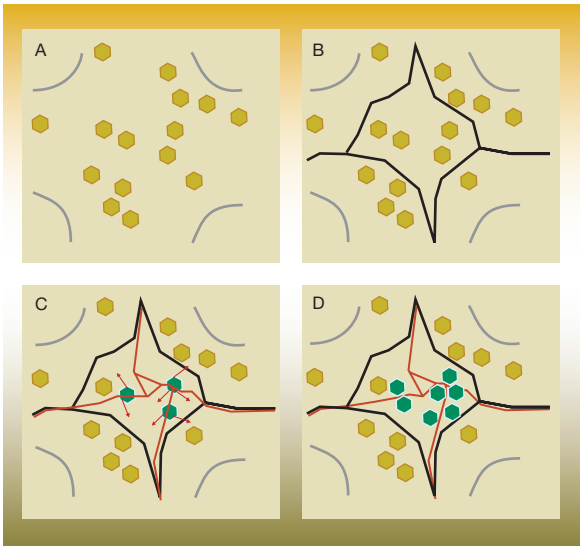
We use an array of different methods to help people prepare a contextually meaningful field of items for sense-making, including:

Narrative database. We might prepare in advance a narrative database of relevant stories surrounding the issue, drawn from oral histories, collected anecdotes, published reports, historical documents, and the like.[40] Workshop participants might be asked to review the material in advance and answer some sense-making questions about it. In the first part of the workshop, we may ask people to talk about their thoughts on the material and the narratives which they found most compelling. From these discussions a list of such items as situations, actors, events, and forces might be generated.

Convergence methods. Rather than pulling items directly from anecdotes discussed, we might go through one of several convergence methods in order to integrate much disparate material and achieve a stronger set of sense-making items. For example, we might ask people to construct composite fables from anecdotes by using one of a variety of fable templates, working from either the narrative database or their own experiences as source material.[41] This exercise is especially useful when we need to bring people into the realm of fiction so that they can more freely express their true opinions on sensitive subjects. It is also a useful integrator of diverse sources. In a room of 50 people constructing fables in small groups, several hundred anecdotes may be considered as material for creation of each group's fable. Items are then drawn from aspects of the integrated fables (characters, events, situations) for sense-making.

Alternative history. Another useful method (with or without preparatory material) is the use of alternative histories. In this method, we ask people to describe the history of an organization, society, or event, always working backwards from the present (to any starting time they think is appropriate). We ask them to determine turning points (moments when small events caused large changes), write them simply on hexagonal sticky notes, and array them on a wall. (We prefer hexagonal notes because people tend to cluster them in beehive shapes, while people tend to categorize square notes.) When the factual history is complete, we then ask people to choose two extreme

Figure 3 Cynefin sample contextualization session



states, one positive and one negative; each of these must be utterly inconceivable. They then work backwards (always backwards, to avoid entrained "what usually comes next" thinking) with fictional timelines to reach points on the factual timeline. These connection points are not determined in advance, but emerge from the growing reverse fiction. The turning points may then be considered and described, listing, for example, actors, communities, and factors in play during those moments. These become the sense-making items.

Next, as shown in Figure 3A, the group comes together with their assembled sense-making items, perhaps derived from multiple processes, and discusses the extremes (not the domains) of the Cynefin space. They consider the corner where everyone knows the right answer, the corner where an expert could be expected to know the right answer, the corner where the situation only becomes clear retrospectively, and the corner in which there is no right answer. If possible, items are selected from the set that exemplify that dynamical extreme in the context of the issue or events being considered. This is an important step, because it begins to build the framework. We say "build the framework" because the Cynefin framework is created anew each time it is used, with distinctions meaningful to the current context. To some extent, it does not even exist in the way we describe it here, devoid of context, but is always used to enable sense-making in a particular setting. (It can also be used to negotiate meaning between contexts, but that use is beyond the scope of this paper.)

After the extreme situations are considered, all of the sense-making items are placed within the overall Cynefin space—without boundaries—where the items seem to fall, using dynamic placement. (We sometimes ask people to think of it as though the item they are placing has four elastic bands connecting it to the four corners, and to find the place where it comes to rest depending on how hard the different bands pull on the item. We then ask them to check the placing of each item in relation to others.) Clusters are allowed to form where items seem similar in the space, but are not required. This is often done in person using large walls and hexagonal sticky notes; it can be done electronically, but must be done socially.

It is important to mention at this point that discussion is encouraged during the placement of items. This is unlike the methods of affinity diagrams, in which people are asked to refrain from speaking.[42] In our experience, although the proponents of affinity diagrams are correct that silence equalizes the verbal contributions of those who speak up and those who hold back, the placement of items is not equalized by silence: often people just watch very carefully what the boss is doing. In a sense this only drives power differences underground rather than removing them. We find it is better to remove large power differences before contextualization; in fact, we have found that comparing the patterns made by people at different levels of management working on separate contextualizations can be of great value, especially for tackling difficult management issues. Another significant element of the placement of items is that, as in the group construction of affinity diagrams, we encourage people to consider all items together and to keep moving any items they like until the patterns they have produced make sense.

When all the items are placed, as shown in Figure 3B, lines are drawn between hexagons that are clearly in one domain or another, leaving a possibly large central area of disorder. Then, as shown in Figures 3C and 3D, the boundary lines are "pulled in" to make the distinctions between domains more complete. Hexagons that lie on the new lines are bifurcated, trifurcated or quartered, forming new clusters of hexagons on either side of the boundaries. This stage involves much discussion, as consensus has to be reached.

At this point, the characteristics of each domain and boundary—as they pertain to the context at hand—can be considered using the sense-making items in place.

Use of the contextualized framework. After the Cynefin framework has been created, we may move on to other exercises in which the items in specific areas (for example, near the boundaries or at the extremes) are considered in more detail—or conversely, in which the entire contextualized framework is used to describe the changing dynamics in a historical case or a contemporary situation, possibly from different points of view.

We should point out here that though we draw the framework as four simple areas in two-dimensional space (because it is quick to draw and grasp), this is only a quick reference for discourse, and that simple drawing expands into something more multidimensional in use. For example, we might ask people to consider different aspects of or perspectives on a single situation that might be located in different areas or moving in different directions. In this sense, all sense-making exercises transcend the simple representation of the framework at some point. We consider the framework to be a "jewel of contemplation" that has many facets, like a geographical information system, in which many layers of information are overlaid so that they can be integrated or separated at will; but the ultimate reality is that every representation (including the entire framework itself) is created for a purpose.

The value of the completed contextualized framework lies in two main benefits. First, nearly every contextualization exercise we have seen has ended with expressions of surprise from those participating. They often see, for the first time, patterns that overturn their entrained beliefs about the issue they are considering and about their purpose, goals, and identity. For example, one group completed their Cynefin framework and reviewed it. They had done alternative histories to derive their sense-making items, and they had been asked to provide at least one accident in each fictional time line. On their Cynefin framework, the only items in the chaos domain were those (color-coded) accidents. One participant looked at them and said, "We are being complacent, aren't we?" The participant meant that they had only been willing to consider wholly chaotic situations when they had been forced to add accidents to the list.

This increased awareness (reflected in many other such stories) is the highest achievement of the completion of the contextualization exercise: that the group should accomplish Descriptive Self-Awareness, or a greater understanding of their own biases and potentials. This is also our goal in helping people go through the process, because it is our place to enable clients to achieve self-awareness rather than to provide "expert" advice, which has a much lower value in practice.

The second benefit of the contextualized Cynefin framework is that it provides a new shared language with which the members of the decision-making group can discuss situations, perspectives and possible actions. This new language is unique to the concerns of the group and abstract enough to cover many particulars, but resonant with meaning so that it tends to be brought up spontaneously when issues are discussed. It can be used to talk about interpretations of current conditions based on gathered data, to evaluate strategic interventions, and to constructively manage conflict and bring about consensus, without removing conflict. Also, multiple groups who have created their own contextualized frameworks can use them as artifacts for negotiation of common meaning. For example, if one group placed "the influence of the Internet on globalization" in complex space and another group placed it in knowable space, both groups would learn something about their respective perspectives. We have been helping groups to use such frameworks to guide discussion among different government branches, for example.

We previously contrasted Cynefin as a sense-making framework with categorization frameworks. We do sometimes use the contextualized Cynefin framework for categorization within a particular context, meaning that the terms used are not generic but specific. Categorization in context has some excellent uses: for example, for training in standard operating procedures, for aligning perspectives and objectives among groups (for example, strategic and operational), or for initiation of new people into the group.

Wider implications

As we mentioned previously, the contextualization exercise is just one of several elements involved in using the Cynefin framework to support people making decisions and crafting strategies. As part of the work we are doing for public-sector and private-sector bodies, including the government, we are design-

ing computer software that uses the Cynefin framework as a sense-making mechanism in tandem with massive narrative databases of world history and contemporary events, in order to support policy-making and decision-making at both the operational and strategic levels in government and industry.

Other elements of our work over the past several years, those having more specifically to do with the use of narrative to enable multi-perspective understanding in the complex domain, are also heavily involved in this work, but we do not have the space to describe them here. They are described in recent papers,[40–41,43] and we plan to feature them strongly in an upcoming book on the subject. Instead, we will delve a little more deeply into some more advanced topics related to using the Cynefin framework.

Boundaries are possibly the most important elements, in sense-making, because they represent differences among or transitions between the patterns we create in the world that we perceive.

Cynefin boundaries

Boundaries are possibly the most important elements in sense-making, because they represent differences among or transitions between the patterns we create in the world that we perceive. Depending on how you look at it, any gradient can be a boundary and any boundary can be a gradient, so there is always room for interpretation. We distinguish between types of boundaries on an experiential basis, in the sense of: How does the essence of this boundary, as I perceive it, affect my sense of the situation and of what I should do? In that sense, the boundaries we consider are more like phase changes than physical boundaries (though they could be physical boundaries, if those boundaries coincide with phase changes).

We use a range of metaphor sets to create an understanding of boundaries. One of the most effective is a geographical set, as follows:

1. The *shallow river* can be crossed by anyone at any place, and thus control over crossing is difficult to achieve. However, it is easy to tell when one has crossed it (or when others have) because one's feet get wet. Most of the important events of our lives (e.g. birth, marriage, parenthood, death) are shallow-river boundaries, because anyone can go through them and they "mark" us with the change. Ritual tends to be strongly associated with this type of boundary. An organizational example might be the transition from a new employee to someone who knows the inside stories of the organization. Maintaining shallow-river boundaries is most useful when you want to encourage as much diverse exchange over the boundary as possible, but still retain the capacity to monitor and intervene.

2. The *deep chasm* can be crossed only at bridges, which can be built, demolished, and controlled at will. It is not easy to tell when one has crossed the boundary, but such a marker is not required because only some are allowed through. An example of a deep-chasm boundary might be the front page of a community Web site that requires visitors to register with their names and addresses in order to participate, but does not record individual movements during regular visits to the site. This type of boundary is most useful when the exchange is too important or dangerous to be left open to all possible movements. The selectively permeable barrier found in our cells is a boundary of this type.

3. The *high plateau* is the boundary with the most potential danger, because you may not be aware that you have crossed the boundary until it is too late and you drop off the other side. One of us once volunteered on a mountain rescue team. The worst place to get lost was on a plateau—there are often heavy mists on high plateaus, and people lose their sense of direction and head directly off a cliff. When you are on such a plateau, it is nearly impossible to know where you will come out. (Those fans of certain science fiction programs will recognize this type of boundary in transportation devices, which offer the enticing possibility of putting you somewhere you had not meant to go.) An organizational example of a high-plateau boundary might be the transition that happens during a corporate restructuring, when groups are wandering around looking for support and no one knows who will survive. There are, of course, times when a high-plateau boundary is just what you need: to confuse an adversary, to promote innovation (in limited circumstances), or to disrupt old patterns that have become limiting.

When we are using the Cynefin framework as contextualized by a group to their context and purpose, we ask them to consider the boundaries between Cynefin spaces by using metaphorical types of boundary. We explain that each boundary might have a different form in one direction or the other, and this is where we must break away from the two-dimensional drawing somewhat. In addition, one boundary might have different forms for different people, whose perceptions or circumstances make their experience of the boundary different. Generally, we find three basic levels of sophistication in the use of Cynefin boundaries for sense-making. First, one considers an awareness of *crossing* the boundary, so that one can respond quickly to new conditions after one has arrived on the other side. Second, one considers an awareness of *approaching* the boundary, so that one can sense when change is incipient and respond before the boundary is crossed (perhaps to cross it purposefully, perhaps to avoid it). Third, one considers *managing* the boundary and the perceptions surrounding it, so that one can, for example, put a deep-chasm boundary in place for one's adversary while maintaining a shallow-river boundary for one's own use.

One thing we have found in using boundaries as part of the Cynefin framework is that different people, with different training and personalities, seem to benefit from different uses of boundaries. People who are used to classifying items into categories benefit from removing boundaries, as takes place in the standard contextualization exercise described earlier. However, people who are used to thinking in a more fluid way—about gradients rather than boundaries—seem to benefit more by constructing boundaries than by removing them.

For example, when the workshop is large enough or when we feel that it is required, we often hold a parallel session of contextualization in which people are asked to distribute their sense-making items along a line, ranging from the most tractable items to the most intractable items. After the line has been completed (and there are many negotiations to place items in relation to each other), we ask people to find places along the line at which they feel that the underlying dynamic has shifted. In other words, we ask them to create boundaries along gradients. We then pull the line into a rainbow curve and place it on the Cynefin framework, with the most tractable items in the known domain and the most intractable items in chaotic space. This produces an alternate contextualization, with the same ultimate effect of creating the Cynefin framework anew, but with a stronger emphasis on the negotiation of where boundaries are found. We sometimes ask people to negotiate boundaries as though they were representatives of the different domains, coming up with a mutual agreement on what the boundary means and where it is placed.

The boundary issue is one on which we continue to pursue a strong research agenda (although of course the entire framework is a work in progress), especially with regard to its use for strategic decision support.

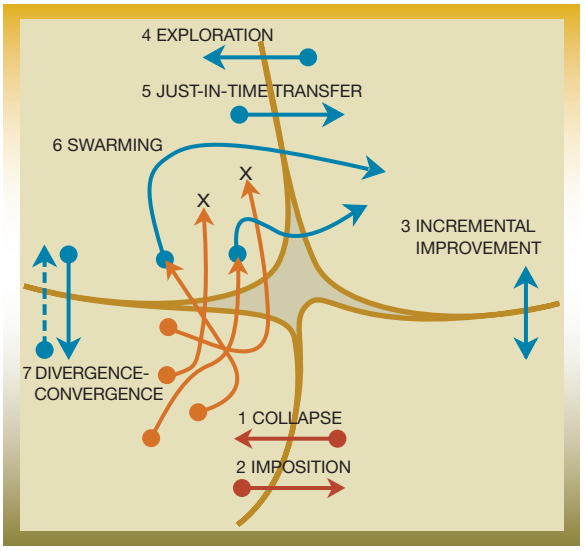
Cynefin dynamics

When people use the Cynefin framework, the way they think about moving between domains is as important as the way they think about the domain they are in, because a move across boundaries requires a shift to a different model of understanding and interpretation as well as a different leadership style. Understanding the differences among the different movements in the framework increases the sophistication of the response of a decision-making group to rapid change. We describe here some of the patterns of movement which we use to help groups consider historical, contemporary, and future change. In general, one of the functions of the Cynefin framework is to increase awareness of the upper domains of the framework and their potential to create sustainable change; several of these movements are designed to make the upper domains more accessible.

Movement at the known-chaos boundary. This boundary is the strongest of the four, in which a perfectly working machine operates inches away from a devastating fire. For that reason, this boundary is the most dangerous—and the most powerful if treated with respect.

Asymmetric collapse (Item 1 in Figure 4) is movement from the known to the chaotic, disastrously. We have seen a tendency for organizations to oscillate between the domains of the known and the chaotic, avoiding the upper domains. Organizations settle into stable symmetric relationships in known space and fail to recognize that the dynamics of the environment have changed until it is too late. The longer the period of stability and the more stable the system, the more likely it is for asymmetric threats or other factors to precipitate a move into chaos. The decision makers in the system don't see things that fall outside the pattern of their expectation, and they

Figure 4 Cynefin dynamics



continue not to see them until finally the system breaks and they find themselves in chaos.

The final stage before the break point is witnessed frequently in history. A good example is the trial of Galileo, in which the Catholic Church accepted that the earth went round the sun for the purpose of mathematic calculation, provided no one said it was actually the case. In retrospect, this was an untenable position, which only delayed and made worse the inevitable collapse. This phenomenon of grasping at order is common in people, governments, academia, and organizations of all shapes and sizes. Often the strongest dominant player in a market will continue with behavior long after its utility, perceived from a different perspective, is exhausted (Boisot[44] uses IBM as an example of this). Also, senior decision makers and their policy advisors will find ways of fitting reality into their existing models rather than face the fact that those models are outdated, and they will punish dissent (the history of science and business provide examples). Galileo is tried afresh in modern organizations on a regular basis.

Imposition (Item 2 in Figure 4) is movement from the chaotic to the known, forcefully. The consequence of asymmetric collapse is chaos, and the consequence of chaos is frequently Draconian imposition of order, in which the situation is so catastrophic that people accept what would have previously been unacceptable as the price of order. The problem with this dynamic is that it introduces a new stability that in turn becomes more rigid until the new order breaks in its turn. A familiar example in organizational life is the cyclic reorganization of authority by industry, then by function, then by industry, and so on in an endless cycle; or the fact that well-intentioned revolutionaries sometimes put into place bureaucracies even more stifling than those they overthrew. However, we do not mean to imply that all such transitions are pathological. When order is well aligned with needs, it can bring needed savings and calm. Anyone who has seen a talented teacher take control of a frantic classroom through authority and respect, or a policeman calm a panicked crowd, can understand the utility of imposed yet well-placed order.

Movement at the known-knowable boundary. This is the boundary where the scientific method is believed to operate, though in practice most agree that some un-order is involved in most scientific work (for example, hunches, analogies, networks, local practices, and shared beliefs). This boundary is fluid and permits much traffic as people go about the business of building technologies and pursuing lines of inquiry.

Incremental improvement (Item 3 in Figure 4) is movement from the knowable to the known and back, repeatedly. This type of movement is the best-known and accepted of the types we list here. For many situations, this remains the movement of choice. In a sense, the cyclic flow of information across this boundary is the engine of technological growth. However, it can become pathological if cyclic movements between known and knowable depart ever further from observed reality (as with, for example, the epicyclic models of the solar system or the "science" of phrenology). This sort of movement should be linked occasionally with one of the larger movements we mention later.

Movement at the knowable-complex boundary. The boundary between the knowable and the complex can be a fruitful one for science, and in practice complements the known-knowable border as an engine of new ideas. It is not as permeable as the known-knowable boundary because transitions must translate between two systems of order and from one set of rules to another.

Exploration (Item 4 in Figure 4) is movement from the knowable to the complex, selectively. This movement is often mentioned in the literature on com-

plexity as exploration versus exploitation.[17] Exploration is an opening up of possibilities by reducing or removing central control without a total disruption of connections. In organizations, exploration takes many forms, but trust is key in this movement. One is, in effect, taking a risk by allowing constituent connections to form and strengthen at the expense of central control, and that requires not only good planning and awareness of the "shadow" side of the organization, but also careful (but unobtrusive) monitoring of the situation. In most organizations there is a strong and often untapped resource to be found in exploratory moves such as this. For example, informal communities, which may range from public to secret in their profile, provide a rich and fertile source of knowledge and learning that is too large and complex to be formally managed. One study of actual practice in IBM Global Services[34] indicated some 50–60 official knowledge areas, complemented by many tens of thousands of private areas. By providing spaces in which members of the organization could naturally share with people they trust, a fertile source of learning was created.

Informal communities, which may range from public to secret in their profile, provide a rich and fertile source of knowledge and learning.

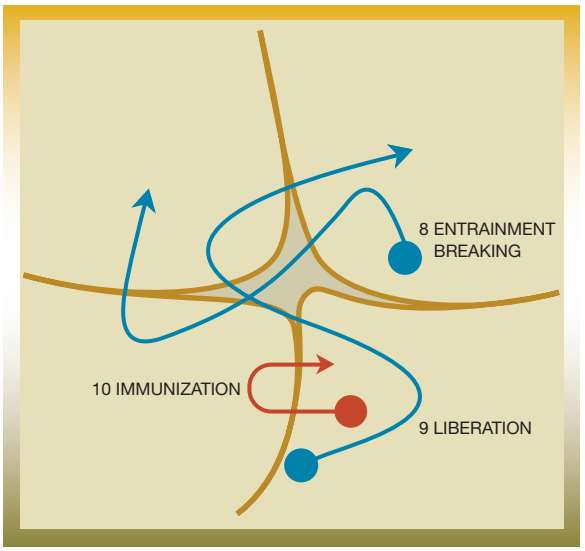
Just-in-time (JIT) transfer (Item 5 in Figure 4) is movement from the complex to the knowable, selectively. This movement is often called exploitation in the complexity literature, and it involves the selective choice of stable patterns in complex space for ordered representation. In the IBM example just cited, the 50–60 official communities are able to draw on information coming out of the informal trust-based communities as long as they refrain from disturbing their delicate balance. Knowledge can be moved into the formal space on a just-in-time basis: knowledge is made available when it is needed. Techniques to achieve this include subject-matter flagging and privacy-ensured searching of content. The issues here are those which gave rise to JIT techniques in manufacturing some decades ago: organizations realized that the cost of maintaining stock on the factory floor was out of all proportion to the benefits, with high levels of wastage over and above stock holding costs. In consequence, stock holding shifted back to the suppliers, entering the factory just in time.[43]

Movement at the complex-chaotic boundary. This boundary, like the known-knowable boundary, is fluid and in fact difficult to delineate. In nature, systems move back and forth across this boundary often. In that sense, traffic across this boundary mirrors that across the known-knowable boundary: one is an engine for technological and scientific order, and the other is an engine for organic order. In the social sphere, we can use the engine of complexity to enable emerging patterns that prove useful.

Swarming (Item 6 in Figure 4) is movement from the chaotic to the complex, to the knowable; first, in an emergent manner and then, selectively. Draconian imposition of order is most appropriate in symmetric conditions and partial remediations, but under asymmetric conditions, or when whole-system interventions are required, we need to move from chaos to the complex, not to the known. The boundary between chaos and order is a chasm difficult to cross, but a vertical transition across the more permeable boundary between chaos and complexity is inherently more manageable. A transition from the chaotic to the complex is a matter of creating multiple attractors, or swarming points, around which un-order can instantiate itself, whereas a transition from the chaotic to the known requires a single strong attractor. For example, if one were trying to evacuate a panicked crowd in a theater on fire, it would make more sense to shout out "the blinking orange lights are above the exit doors," which is a complex swarming-point trigger that relies on local knowledge only, than to shout out "come towards the back of the theatre," an ordered trigger that relies on global knowledge which may be unavailable.

After we have achieved the shift from chaos to the complex, then we have the possibilities of many patterns forming around the new attractors; those we find desirable we stabilize through a transfer to the exploitable domain of the knowable; those that are undesirable are destroyed. We have found in several recent engagements that the contrast of *swarming* with *imposition* provides a new language for executives and appears to provide new perspectives on crisis management. We will be studying actual behavior and creating more "subjects" in this field over the next year as our use of dynamic movements within the Cynefin framework develops.

Figure 5 Cynefin dynamics using chaos



Divergence-convergence (Item 7 in Figure 4) is a movement from the complex to the chaotic and back, repeatedly. The active disruption of a complex system to precipitate its move to chaos is less of a change than moving it to either of the ordered domains, and this is easier to manage across a permeable boundary. In knowledge management, for example, informal communities that occupy the complex domain are more resilient when asked to undergo radical disruption in an innovation program than the expert communities of the knowable domain.[39] Small start-up companies handle disruption better than large bureaucratic ones, but even within large bureaucratic organizations, there are small groups that can act in the role of start-ups, and they can increase the adaptability of the organization.

Our complexity-inspired workshop techniques, as explained above, make intensive use of the boundary between the complex and the chaotic, in effect cycling between the dynamics of the two states as a sort of pattern generator to create a rich variety of patterns among which to choose—to stabilize and to disrupt—in order to facilitate sense-making.

Visiting chaos

There are some good reasons to move deliberately from order to chaos. There are times when it is necessary to break rigid structures in precipitation of a natural collapse (as one approaches the boundary), so that the transition can be managed more carefully; and there are times when a strong disruption is the only mechanism that will break up a strong but unhealthy stability. The last three movement types we will consider use the chaotic space for temporary disruption of all connections (possibly within a restricted context) as a stimulant to new growth.

Entrainment breaking (Item 8 in Figure 5) is movement from the knowable to the chaotic to the complex, periodically. In entrainment breaking, we move from the knowable to chaos and thus stimulate the creation of new complex systems as the system rebounds into the complex domain. This is a common approach to disrupt the entrained thinking of experts who, in our experience, tend to be the most conservative when it comes to radical new thinking. The move to complex space is not radical enough to disrupt those patterns; we need to challenge at a more basic level the current assumptions of order. By using the complex space as a staging post, we create a more fertile space of interactions from which we can select stabilization points for the movement to the knowable. A knowledge management example is the creation of formal communities by clustering and swarming informal activities from existing trusted relationships.[39] In strategy, this method can be used to create and validate new sources and structures for decision-making.

Liberation (Item 9 of Figure 5) is movement from the known to the complex to the knowable, periodically. Organizations tend to assume that they can design the nature of new systems. For example, an organization that needs new expertise in an area might commission a university to carry out a study, recruit specialist staff, or identify individuals within the organization and assign them new responsibilities. This is a successful and effective strategy when the conditions are suitable for ordered approaches. However, if the situation is uncertain, it is more useful to shift the problem from the domain of the known to the complex. Organizations need to increase both internal and external levels of contact to the point where new patterns can emerge. Boisot[44] makes the point that companies need to use both hoarding strategies, in which they place defensive barriers around what they know and focus on exploitation, and sharing strategies, where knowledge is shared within and outside the organization with the intent of increasing the volume of opportunities, with the strategic advantage shifting to speed of exploitation of knowledge.

For an organization, sharing strategies involve a process of letting go, of creating freedom within heuristic boundaries to allow new patterns and new leadership to emerge. One of the techniques we use in this area is Social Network Stimulation,[39] which aims to stimulate the interactions of agents (or rather identities) within systems to allow the emergence of new coalitions, alliances, and leadership. To use a metaphor, we cast seeds (ideas, deliberately ambiguous goals), which are cheap, across a broad landscape and see where growth occurs. As soon as growth is evident, we respond quickly to shift the newly emergent idea or leaders or coalition into the knowable. We have called this movement *liberation* because it breaks the entrainment of bureaucracy—but like all letting go, it is difficult. This is one of the most threatening of transitions to entrenched managers, but one of the most important.

Immunization (Item 10 of Figure 5) is movement from the known to the chaotic, temporarily. Immunization in chaos is a smaller "visit" to chaotic space that shakes up "the way things are" enough to cause reflection but not enough to destabilize the entire system. Immunization serves two purposes. First, it inures people to the devastating force of chaos so that they will be better prepared to face those forces in the future. A perfect example: it is said that the great director Buster Keaton was able to craft his death-defying stunts (such as a house falling around him, a rescue from a drenching waterfall, amazing pratfalls, and so on) because as a toddler he was lifted out of bed by a tornado and set down unhurt in the street.[45] Second, immunization brings new perspectives, which cause radical disruptions in stable patterns of thought and lead to new complex patterns. Examples of such events are scattered throughout literature, in the accident that changes a politician's career, or the chance encounter that causes a lonely woman's life to fill up with new meaning, or in many other kinds of radical departures that make everything on which one had relied seem meaningless and restricting.

Metaphors are particularly useful agents of immunization because they allow conversation about painful things, enable disruptive and lateral thinking, prevent entrainment of attitudes, and clear out the cobwebs of stagnant ways. One technique we use for this purpose is called the "Grendel game" (material available from the authors, not yet published), which combines anthropological study, complexity theory, and managed war games to create an exciting and innovative learning event. Here, following a study of the organization, using anthropological techniques developed and proven within earlier research into anecdote collection, a fictional planet is populated by aliens selected to reflect the current culture and new scenarios. This is done with a leading scientist, who in his spare time designs consistent alien environments for use by science fiction and fantasy writers. Members of the organization then seek to colonize the planet in a managed war game. They face their own organization in a metaphorical setting that allows more profound and meaningful learning. Newness is simulated without threat, and the participants are habituated to perspective shift and uncertainty.

Background movements

In any consideration of deliberate change, one must consider what is already going on. The forces of the past tend to cause clockwise drift in the Cynefin space: people living together and sharing mutual needs lead to the emergence of ideas; convenience leads to stabilization and ordering of the ideas; tradition solidifies the ideas into ritual; and sometimes, either lack of maintenance or the buildup of biases leads to breakdown. The forces of the future push dynamics to the counter-clockwise: the death of people and obsolescence of roles cause what is known to be forgotten and require seeking; new generations filled with curiosity begin new explorations that question the validity of established patterns; the energy of youth breaks the rules and brings radical shifts in power and perspective; and sometimes imposition of order is the result. In a sense, these two forces are always pulling society in both directions at once, and this is reflected in organizations as well. The old guard is forgotten at the same time that its beliefs affect newcomers in ways they cannot see. An awareness of these dynamics in the organization must precede any deliberate attempt to affect it by deliberate change.

Use of Cynefin dynamics in practice

Our use of the boundary transitions described here relies on narrative because boundaries are essentially about change and narrative is about change. We may ask people to consider a situation in the past and what movements took place in it from different perspectives, or we may ask people to envision fictional narratives about the past, present or future in which selected movements form the backbone of the story. (Remember this is all done not in the abstract, but using the contextualized Cynefin framework that

makes sense in the context of concern.) These narratives of change are used in the sense-making process, in which they may be quickly created and discarded, or they may be saved and used to generate a shared language about change in much the same way as cycles of folk tales long ago. They are not, however, allowed to stabilize into expectations; they must remain fluid to be useful.

A critical distinction between this type of narrative generation and that of scenario planning[46–47] is that the source of Cynefin-based narratives is not a set of expected ranges of expected variables, but a consideration of dynamics in which the variables and ranges are sometimes unknown and perhaps even unspecified. This creates a more diverse, flexible, and changeable set of narratives that should be truly surprising. For example, a scenario-planning exercise done by a police force might result in scenarios exploring the space from high to low crime, corruption, and terrorism. These scenarios are useful in considering a future in which those axes are the most important—but what about the situation where they are overridden by a previously irrelevant factor? Narratives generated using a contextualized Cynefin framework explore spaces in which the dynamic situation arises from any source. Optimally, a wide range of diverse possibilities (chaos from a nuclear accident, a coup, an epidemic, an alien invasion) is best, even though some scenarios might be inconceivable or even nonsensical. Conceivability is not the point: preparation for the unexpected is.

Note that we do not believe these methods should supplant scenario-planning in all contexts, because that method works well in knowable space, where its results are productive. We do believe, however, that these are the methods of choice in complex situations where a wider range of possibility needs to be explored. In fact, as we increase the number of methods available for the un-ordered domain, methods that work well in the ordered domain get even stronger because they are no longer used in situations in which they have limited applicability.

Relationship to other frameworks

We do not pretend that all the basic ideas inherent in the Cynefin framework are new or unique. They can in fact be found floating around history for thousands of years. The distinction between order and un-order (and their interactions) is ancient, as we mentioned, as well as being taken up by recent authors.[48] The chaotic-complex distinction has been much debated in recent years, with some saying complexity exists at the "edge of chaos,"[10] some saying that the two phenomena have separate origins and cannot be placed together,[19,49] and some even saying that the distinction is artificial and arbitrary.[50] The distinction between known and knowable is widespread and goes back to ancient philosophy. We do claim originality for the development of the ideas behind the framework in its full form (as we have described it, and in some other aspects outside the scope of this paper) and for the methods we use to make the framework useful in practice (though of course they have their relationships with other action research and sense-making methods).

As we increase the number of methods available for the un-ordered domain, methods that work well in the ordered domain get even stronger.

Courtney's[51] framework, in which he distinguishes between four states of increasing "residual uncertainty" (uncertainty that cannot be reduced by analysis) questions universal assumptions about the use of known-space methods and tools. He does seem to believe, however, that the level of uncertainty can be "defined"—that is, he has no domain of disorder (which is essentially a state of uncertainty about uncertainty). This, we suspect, may cause people to gravitate to the domain they find most plausible, as we have seen happen. Also, his "toolkits" of choice for each level of uncertainty seem to cover only the known and knowable spaces in the Cynefin framework, with a slight nod to narrative methods in complex space. In effect, he does not break out of the righthand side of the Cynefin framework. He also does not seem to consider the possibility that a single circumstance may contain competing aspects and perspectives with different degrees of uncertainty or that such differences can be used to strategic advantage. Certainly there is much to be gained from all attempts to diversify responses to differing contexts, however.

Returning to assumptions

To complete our circle, we should address the three assumptions we identified at the start of this paper.

As we said at the beginning, these assumptions are valid in some circumstances, but not in others. Let us examine each one again and consider how we can expand these assumptions to a universally applicable set. We will also briefly speculate on emerging applications of the Cynefin framework to management science and practice.

The assumption of order. Relaxing this assumption is the basis of the Cynefin framework, which proposes instead two types of order, each with distinctions inside, and a recognition that uncertainty may exist in distinguishing these types (the domain of disorder). The assumption of order holds for ordered space, the known and knowable, so we need new assumptions for the domains of un-order and disorder. In complex space, we can safely assume that patterns will form, unpredictable in their details but usually recognizable in their basic forms, and that with practice we can learn to detect these forming patterns, stabilize or disrupt them depending on their desirability, and seed desirable patterns by creating attraction points. In chaotic space, we can assume that all connections have been broken, that possibility reigns, that old patterns have been disrupted, and that the outcome is not predictable. In the space of disorder, we know something very valuable—that we do not know. We need to gain more understanding (in every way possible) so that we can find patterns and react to them.

In management, relaxing assumptions of order means recognizing that not all effective solutions are efficient solutions. It does not mean that trust has to be given blindly or that complex processes cannot be affected; it only means that when the means match the context, less energy need be expended for the same result. In a very real sense, managers have successful models available in the domains of un-order in the way they manage their children; they use boundaries and interventions to encourage desirable behavior but do not attempt to control it through goal-based direction. The use of these methods is opening some high-potential developments in managing organizations following mergers and in creating the conditions for continuous learning and innovation.

The assumption of rational choice. Relaxing this assumption means that context and perspective become as important as rationality. This is an important reason that the Cynefin framework is not about "objective" reality but about perception and understanding; it helps us to think about the ways in which different people might be perceiving the same situation. For example, there is an old folk tale from India[52] in which a wise man decides that in order to escape an impossible royal demand, he will fake insanity in the king's court. He is operating in complex space because he is using cultural shorthands to provoke predictable reactions but is gambling that his ruse will seed the pattern he wants to create. He knows that from the perspective of his audience, who are operating in the space where things are bound by tradition and thus known, he appears to be acting chaotically, because they can conceive of no other reason for him to act this way in front of the king (who would surely behead him if he was faking). Thus by proving that he cannot be faking, he pulls off the fake. Understanding not only that there are different perspectives on an event or situation, but that this understanding can be used to one's advantage, is the strategic benefit of relaxing this assumption. Narrative techniques are particularly suited to increasing one's exposure to many perspectives on a situation.

In management, there is much to be gained by understanding that entrained patterns determine reactions. This realization has major implications for organizational change and for branding and marketing. Our own work on narrative as a patterning device is gaining presence in this and other areas. Speculating, one of the most significant possible applications of this understanding is a move away from incentive-based targets and formal budgeting processes—both of which, we contend, produce as much negative as positive behavior. It is a truism to say that any explicit system will always be open to "gaming." Paradox and dialectical reasoning are key tools for managers in the un-ordered domains.

The assumption of intentional capability. The effect of relaxing this assumption is also one of considering context, but more of context on action than on perspective. It means asking not, "What did they have in mind when they did that?" but, "What does it mean that this happened?" John F. Kennedy was presented with such a dilemma when he received two letters in rapid succession from the Soviets during the Cuban missile crisis, one conciliatory and one hard-line.[53] Which letter was a wink and which was a blink? It turned out, of course, that both letters were winks but of different actors (Khruschev and the Politburo, respectively). The different authors of the letters probably saw their actions from the complex space of the Cynefin framework because they understood the internal politics that produced them.

To Kennedy, however, receipt of the two letters plunged him into chaotic space, where he could conceive of no sensible intention to send such contradictory letters—to confuse, perhaps, or to delay while the missiles were being prepared. It was only after scrutiny by linguists that the Kennedy administration was able to understand that the intentions behind the two letters came from different sources. This moved his understanding into complex space where he could respond. It is only possible to consider alternative explanations for actions when one relaxes the assumption that all actions are deliberate.

In management and in strategy, the issue of assumptions about intentions can have pronounced effects. For example, one may assume that the rejection of a new initiative by employees is intentional, when in fact it is an accident of emergent patterns of interaction. Treating the rejection as intentional may create exactly the reaction that the managers wished to avoid in the first place. The same is true of over-reaction to accidental competitor behavior that is presumed to be intentional.

Conclusion

This paper outlines a new approach to strategy, both in policy formation and in operational decision-making. While it is new, this approach also recognizes as critical the value of what has been done to date. As such, it starts to break the fad cycle that has bedevilled management science for several decades. It recognizes the progression of human knowledge, in that something which has provided value is not rendered valueless by new thinking, but is bounded by new insight and legitimized within boundaries, and thereby, made more, rather than less, effective. This approach is, we think, unique in that it recognizes the value and interaction of order and un-order. As such, it also allows us to make a critical distinction between efficiency and effectiveness. Human groups need to be effective; machines and structured human interactions (such as manufacturing processes or the application of rules of engagement) need to be efficient.

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Accepted for publication April 24, 2003

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Can the Liberal Arts and Entrepreneurship Work Together?

Liberal arts courses aren't meeting students' needs, but we can't just turn them into business courses.

By Mary Godwyn

Sequestered far from rough-and-tumble, real-world considerations, often viewed as too theoretical to be useful, a liberal arts education is associated with thinking and contemplation rather than praxis. Entrepreneurship, on the other hand, is almost always situated within the domain of business and involves some type of market exchange, giving it immediate economic significance. Risky, exciting, and fast paced, entrepreneurship represents not only engagement with the outside world, but also the attempt to change the world according to a particular vision. In his 2007 *Newsweek* college guide, "Twenty-five Hottest Schools," education journalist Jay Matthews describes liberal arts offerings as "intellectual" and entrepreneurship courses as "careerist." Yet even proponents of entrepreneurship education complain of an absence of rigor in much of the available research, and the foundational theory of entrepreneurship remains largely unarticulated, driving doubts about its qualifications as an academic discipline. Critics maintain that entrepreneurship programs do little more than promote profit-driven, commercial enterprise. Liberal arts and entrepreneurship have a common foundation, but they have erroneously become defined as polar opposites within the academy; thus, the power and effectiveness of each have been undermined. The solution is for those in liberal arts and entrepreneurship programs to work together—without driving each other crazy.

The Business Context

Entrepreneurship programs are growing at an astonishing pace. According to *Fortune* magazine, three thousand colleges and universities offered some form of entrepreneurship education in 2007. Entrepreneurship courses are the fastest growth area in business and engineering schools; moreover, colleges and universities, in their efforts to attract students and increase the economic utility of undergraduate degrees, have begun introducing entrepreneurship programs in liberal arts schools.

Entrepreneurship professors routinely insist that their discipline is distinct from business management and that entrepreneurs are not merely business owners. Syracuse University entrepreneurship professor Michael Morris writes, "Entrepreneurship is the most empowering, the most democratic, the most freedom-creating phenomenon in the history of the human race." William Scott Green, part of the Kauffman Campuses Initiative promoting the teaching of entrepreneurship, suggests that entrepreneurship can be seen as "an antidote to the alienation that both Marx and Weber saw as the ineluctable trait of capitalist modernity. In Marxist terms, entrepreneurship can be seen as the reverse of alienated labor, when workers do not own what they produce. In some basic sense, the entrepreneur is at one with the enterprise of her or his devising." Green and Morris agree that colleges and universities should make "every student an entrepreneur."

When discussing actual classes and curricula, however, entrepreneurship quickly and inexorably becomes conflated with typical business offerings. For example, at Syracuse, contexts for entrepreneurship include start-up ventures, early-growth firms, family businesses, rapid-growth ventures, corporate entrepreneurship, academic entrepreneurship, and cultural entrepreneurship;

the latter two are only vaguely defined. In its integrated Entrepreneurship and Liberal Arts program, Wake Forest University offers undergraduate students an entrepreneurship minor. Even in the program's integrated courses, however, entrepreneurship education continues to be directed toward business objectives. In Teaching the Business of Art, an elective course, Wake Forest students are paired with "successful working artists and skilled professionals to introduce and strengthen the entrepreneurial skills needed to make a living as an artist." In this integrated course, the idea that entrepreneurship and entrepreneurial thinking can be integrated within the study of art itself rather than used merely as a means to market and sell art has not yet been articulated and implemented.

Despite the desire to develop university courses so that students encounter, in Green's words, "entrepreneurship in regular mainstream disciplines—from philosophy to history to chemistry," we have not adequately formulated how entrepreneurship can be integrated into liberal arts courses without turning them into business courses. Moreover, though there is widespread desire among entrepreneurship aficionados to claim that entrepreneurship involves more than just business skills, no description of entrepreneurship yet exists that would qualify it as a philosophy of life, an attitude, a mindset. To date, entrepreneurship has been imprisoned within a business context largely because the subject matter has been governed by the pedagogy and objectives of business schools rather than those of liberal arts education.

The Liberal Arts Context

We cannot ignore the fact that the liberal arts are not meeting many students' needs. The number of business degrees granted by colleges and universities has been rising, and only a small percentage of twenty-first-century college students are choosing liberal arts majors. As increasing focus is placed on vocational education, liberal arts courses can seem anachronistic, even useless.

Defenders of the liberal arts argue that liberal arts disciplines teach the critical-thinking skills leaders need to make sound decisions, and in our complex democracy, each citizen is a leader, choosing for herself or himself who will govern and by what policies. Political writer Michael Lind writes, "In a democratic republic, isn't it necessary for all citizens to have at least the basics of a liberal education? Even if their participation in public life is limited to voting occasionally, citizens cannot adequately perform that minimal duty unless they have the training in reasoning, rhetoric, and fact that in aristocratic and patrician republics was needed only by the few."

However, liberal arts programs must acknowledge the pressing pecuniary concerns that many students face, such as significant postcollege indebtedness, and articulate the economic utility of a liberal arts education. The liberal arts can situate practical skills in a context of ethical decision making that addresses public good and community perspectives. Foundationally similar, the liberal arts and entrepreneurship share the same critical, forward-thinking orientation: they involve the study and analysis of what *is* (for example, the current state of the economy, social justice, citizenship and community affairs, business environments, and public and private needs) and, by identifying and evaluating opportunities for improvement, consciously contribute to *what will be*. The liberal arts are distinguished from the servile arts because they focus on subjects that are worthy in themselves rather than those that are worthwhile only insofar as they are a means to the cash economy, material benefits, or increased social status. This distinction is also what separates an entrepreneur from a mere business owner. Entrepreneurship is a tangible, practical manifestation of a liberal arts sensibility; it has economic ramifications that extend the ability of the entrepreneur to engage with social discourse—to develop and express personal identity by influencing the larger social context. By situating entrepreneurship within the academy, we can legitimate the practical, material dimension of the discipline to the degree that entrepreneurship shares the values of the liberal arts:

commitment to selfexpression, debate, creativity, problem solving, and the ongoing articulation of the mutuality of social responsibility and personal identity.

Integration

Some educational institutions have already begun to integrate liberal arts and entrepreneurship courses; however, integration of liberal arts and entrepreneurship curricular and cocurricular activities often lack a coherent rubric with which to define and evaluate integration. Given the current, lopsided valuation of material and economic directives, business concerns tend to dominate such integration efforts. We need a template that can be used in crosscampus initiatives to integrate entrepreneurship into any liberal arts discipline with special attention to preserving disciplinary integrity. I suggest a rubric (see related articles) in which enterprise development is only one of four possible outcomes that define an integrated course. Liberal arts professors would not be asked to teach business or to direct their disciplines toward a business outcome; they would, however, be asked to identify the real-world applications of their disciplines as well as to reinforce the traditional fundamental aspects of liberal arts education that situate responsibility and agency in the student.

Entrepreneurship education is now part of many liberal arts institutions, and that is a good thing. However, liberal arts and entrepreneurship faculty members themselves must articulate and interpret the objectives and outcomes of course offerings. We can do that by doing what we do best: critically examining the process to ensure that courses are consistent with the values and goals of liberal arts education. By recognizing common foundations and objectives, liberal arts and entrepreneurship faculty can work together *without driving one another crazy!*

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Creating a LIberal Arts Course the Intergrates Entrepreneurship

1. Study entrepreneurship from another disciplinary point of view. Following are examples of courses that could involve the study of entrepreneurship:

- The Sociology of Business Ownership: Self-Advocacy among Marginalized Populations
- The History of Entrepreneurship in Cleveland among Lebanese Americans
- The Economics of Entrepreneurship during the Great Depression
- Common Psychological Characteristics and Patterns of Behavior in Entrepreneurs
- Business and Social Change: Gender, Race, and Class Characteristics in Entrepreneurial Endeavors
- Entrepreneurship, Innovation, and the Influence of Rembrandt in the Dutch Golden Age

2. Incorporate the entrepreneurial process into other courses through assignments and classroom practices (entrepreneurial processes should be explicitly stated in the syllabus as course competencies, and evaluative guidelines should also be articulated). Possible approaches could include the following:

- Give students leadership responsibility for course outcomes.
- Allow students to share in evaluation of work (both their own and those of their classmates).

- Have a “real-world” aspect to the course—for example, by having students form an organization, raise funds for a cause, participate in activist work, engage with the community, conduct ethnographic research, or complete an internship.
- Focus on problem solving, consensus building, and teamwork.
- Develop competency in making persuasive, sound arguments.
- Develop spontaneous solutions through assignments that encourage students to think on their feet.
- Demand originality, creativity, innovation, and novelty.
- Make it safe to make mistakes.

3. Educate students to open a for-profit or nonprofit enterprise. Students should engage in the business and organizational basics of enterprise development and, in equal measure, with the ethical, social, and environmental considerations entailed in any business creation. When students create a business plan, they should

- discuss the effect of the enterprise on a wide range of stakeholders and consider factors such as markets, funding, and economic viability;
- articulate the social, cultural, and environmental impact of products and services as well as the ethical implications of the business enterprise;
- consider how the product or service would affect business owners, consumers, employees, the local community, the larger culture, and the environment.

4. Help students develop characteristics of the entrepreneurial mindset, including willingness to take risks, innovativeness, creativity, confidence, critical-thinking and problem-solving abilities, the ability to identify opportunities, leadership ability, understanding of value creation, the ability to communicate effectively and present ideas clearly, and willingness to consider multiple viewpoints.*

A sample syllabus from Minority Voices in Entrepreneurship: The Democratization of Influence and Resources, an integrated sociology and entrepreneurship course taught by the author of this article, is available .

* Stephen Zabor of Hiram College articulated this fourth criterion of an integrated course.

IBM's Role in Creating the Workforce of the Future

Executive Summary

IBM was one of the first technology vendors to partner with universities and other organizations to educate the type of IT professionals required to build, run and optimize the types of IT infrastructures and solutions that became the foundations of 20th century organizations.

Although the vendor is certainly continuing with its IT-focused efforts, technology has become an integral component of all organizational functions and processes. It is, therefore, no longer sufficient to educate a small percentage of knowledge workers to become IT professionals. As discussed extensively in Tom Kucharvy's blog, IT professionals must now understand business needs and all knowledge workers must understand how IT and other tools can be used to enhance their own work. IBM, therefore, has shifted its primary university collaboration and internal employee development efforts away from educating deep, but narrowly-focused specialists, to create a new type of 21st century knowledge professional—what IBM calls a "T-shaped person."

These T-shape people—whether IT professionals, business professionals or public service professionals—must be interdisciplinary, rather than narrowly-focused specialists. Although they must certainly have deep skills in a specialty (the vertical axis of the T), they must also have sufficient understanding of a broad range of related disciplines (the horizontal axis) to allow them to see contextual linkages, to constructively participate in interdisciplinary teams and to continually adapt their visions and their contributions to rapidly changing conditions and needs. But whatever an individual's specialty (whether computer science, engineering, marketing, finance or any other field), all must understand how to apply IT tools to the needs of their profession.

Therefore, IBM is adapting how it works with universities to leverage its traditional relationships with IS, engineering and business departments, into all types of disciplines—from psychology, through public affairs through medicine. These new relationships are multi-faceted, including everything from help in designing courses and curricula; providing required hardware and software; funding research, scholarships and internships; and helping to create interdisciplinary research centers that bring together academics, businesses and government officials to address gnarly problems in areas including healthcare, transportation, energy, food safety and environment.

IBM's initial goal in creating T-shaped professionals and research centers is to feed the company's own need for qualified people. It selects future employees from among this expanded pool of graduates and is adapting the company's internal employee development programs to transform these interdisciplinary graduates into solution-focused professionals who can proceed through any of five broad IBM career paths.

But if these efforts go as anticipated, they will accomplish much more. They will help promote independent research that is aligned around IBM's primary market objectives, provide solution-

focused employees for IBM customers and partners and, ideally, inspire a new generation of students to understand how they can use IT (ideally IBM's IT) to bring new value to their own fields. Ideally, many of these fields will align with the rapidly expanding sets of market needs IBM is addressing under its Smarter Planet initiative.

Key Points

IBM is expanding and refocusing its Academic Initiatives.

It is leveraging its current efforts around preparing information science, engineering and business students to helping all types of academic disciplines more effectively apply IT tools to their own requirements.

IBM's goal is help promote the creation of T-shaped people.

These graduates have deep skills in their chosen discipline, broad understanding of a number of complementary fields and complete familiarity and comfort in using IT to address their needs.

IBM's Academic Initiative has three primary goals, and multiple secondary goals.

Its primary goals are to help shape students' education, to help recruit the types of students IBM will need, and to help align university research around IBM's objectives. Secondary benefits include engagement with universities in the design and promulgation of business and government solutions and the creating of recognition and good will among potential IBM customers.

IBM is complementing its university program with enhancements to its employee development programs.

Once hired, every employee creates a custom self-directed career path, and gets access to career coaching and to a tool that recommends and delivers educational materials. The company, which spends about $600 million per year on employee development, is increasingly structuring assignments and career paths in a way that will develop each employee's T-shaped skills.

These efforts have the potential of yielding many indirect benefits to customers, partners and IBM.

They can help create a new generation of IT-savvy, solution-focused recruits for customers and partners, spur research around key market needs, and dramatically expand the visibility around and utility of IBM Smarter Planet initiatives.

IBM's Role in Creating the Workforce of the Future

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IBM's Role in Creating the Workforce of the Future

Introduction: Smarter People for a Smarter Planet

IBM has a history of identifying the type of people that it, its partners and its customers will need in the future, and then in working with universities and other partners to ensure the availability of these people. Back in the 1950s, when IBM was seeking to ensure the availability of professionals capable of driving adoption and utilization of IBM mainframes, the company, both directly and through organizations like the Association for Computing Machinery (ACM), partnered with universities to create Information Science curricula and courses. These efforts, combined with similar actions by dozens of other IT vendors and organizations, spawned generations of professionals that have been instrumental in establishing IT as a critical foundation of virtually all 20th century organizations.

Relationships between IT vendors and universities have dramatically expanded over the last 6 decades and have matured into a series of mutually beneficial teaching, recruitment, research, and, in some cases, even sales relationships. IBM and other vendors will continue to expand and enhance their relations with university Information Science and Electrical Engineering departments as highly-trained IT specialists will always be needed.

Changing IT Educational Requirements

IBM, however, now sees a need for a new form of IT education—an education in which IT is not the focus of a deep, specialized curriculum, but where it is one of a range of core, interdisciplinary, horizontal skills that complements deep vertical expertise in another field. As explained by Dan Reed, Vice Chancellor for IT at the University of North Carolina, this new focus is where IT becomes "the liberal arts for the 21st century"—a set of IT skills, for example, that allows a marketer to seamlessly integrate analytics into an examination of customer behavior or a biochemist to sequence DNA. IT, in other words, becomes one of a broad set of interdisciplinary skills, like communications, teamwork and cross-cultural sensitivity, that will be required to thrive in any chosen discipline.

True, the vast majority of Millennials are already highly comfortable with—and highly competent in—using all type of digital tools. However, while knowing how to use these tools is necessary, it is not sufficient. They must also know how to apply the tools to real-life business needs.

IBM Academic Initiative is a program targeted at addressing these higher-level requirements. For example, it is adapting its educational outreach programs, its recruiting efforts and its employee development initiatives to facilitate the education, hiring and career development of what it calls "T-shaped" people, those with deep skills in a particular discipline, but enough of an understanding of complementary fields to understand concepts, appreciate requirements, recognize patterns, adapt to change and constructively contribute to interdisciplinary dialogs and teams. This type of interdisciplinary education has the potential of helping:

- Individuals develop skill sets that will deliver greater business value to employees while simultaneously combining traditional left-brain analytical capabilities with right-brain synthesis skills in a way that will more effectively differentiate their skills in a global economy; and

- Universities educate students in the type of skills that will be increasingly required to win and strive in tomorrow's high-value jobs, while simultaneously allowing the universities to develop the type of interdisciplinary research centers that will more effectively differentiate their curricula.

Win/Win Opportunities

This program has the potential of helping students, professors, universities and IBM itself. It will, for example:

- Allow the company to reach many more students in many more academic departments than was previously possible;

- Help professors enhance their courses and provide them with more opportunities to partner with IBM on joint research initiatives;

- Enable universities to better prepare their students for attractive jobs; and

- Provide IBM with a larger pipeline of potential employees that have the types of backgrounds for which the company is looking.

Of even greater importance, the program ultimately has the potential of seeding IBM customers (corporations, governments, start-up companies, as well as universities themselves) with professionals that see the world in the way that IBM sees it and that have a favorable view of the company. This can be instrumental in helping IBM build a market for some of the vendor's most critical, differentiating initiatives, including:

- *Smarter Planet*, in which current infrastructures and processes are transformed by instrumenting, interconnecting and adding intelligence to them (http://www.ibm.com/ibm/ideasfromibm/us/smartplanet/index.shtml);

- Service Science, Management and Engineering, in which all types of service processes are systematically reengineered (as manufacturing processes already have been) to make them more standardized, repeatable and efficient (http://domino.research.ibm.com/comm/research.nsf/pages/r.servsci.html); and

- Business Analytics and Opti*mization*, in which software is used to sift, analyze and extract accurate and actionable business intelligence from huge data stores (http://www-935.ibm.com/services/us/gbs/bus/html/bcs_centeroptimization.html).

In other words, IBM's new interdisciplinary academic and workforce development initiatives are intended to do for the IBM of the 2000s, what its Information Science initiatives did for the IBM of the mid-1900s.

This report examines how IBM is working with universities to create these new curricula, bring new skills into the company and develop its employees' skills to most effectively capitalize on the opportunities of the 21st century. It briefly summarizes IBM's traditional university-based IT educational programs, drills down into its new interdisciplinary initiatives and assesses how these programs are likely to feed and reshape the development of IBM's own talent pool. It then suggests how these efforts may play out in the market and the implications for IBM customers, partners and competitors.

Section One: The Evolution of IBM's Academic Initiatives

IBM is far from unique in its work with universities. Although IBM was one of the first, virtually all leading technology vendors now have academic initiatives in which they seed universities with their hardware and software, work with professors to develop classes for teaching their products, engage professors in joint research projects and recruit students. IBM, like other vendors, is extending the scope and reach of its own university technology education programs through means including new courseware, delivery models and engagement programs.

Evolving Tools

IBM's university Academic Initiative program is targeted primarily at helping all types of higher education institutions—from community colleges through leading research universities—educate information science and, secondarily, business students, on IBM products. It provides big discounts on or free access to IBM hardware; free downloads of IBM software and courses; free access to newsletters, videos, case studies and product roadmaps; and an academic version of the sandbox, in which professors can test and provide feedback on new IBM technologies.

It produces instructor-led and self-paced courses, online testing and certification programs. IBM is rapidly adapting this program to accommodate how today's students wish to learn. It provides downloadable courses, community portals and wikis for information access; discussion forums and blogs for communications; and communities around Facebook, Twitter and other social networking tools. It has even begun to use gaming, as with its interactive, 3D INNOV8 Business Process Modeling (BPM) simulation game. It is encouraging and helping schools and professors move toward more student-led (in additional to traditional instructor-led) programs, adopt interactive distance learning systems and use IBM tools to create virtual learning environments and simulation tools. The company is also providing closer direct links with students through scholarships, fellowships, internships and summer jobs.

Although IBM develops most of these courses itself, it also works with a broad range of third-party partners. Partners include:

- *Professors*, to adapt IBM courses (such as for Websphere) for use in their classes and to demonstrate how IBM technologies (such as Blue Gene) can be used to address real-world problems;

- *Corporate customers*, to help local universities produce graduates with required skills such as working with the University of Arkansas to teach the types of mainframe skills required by Wal-Mart;

- *Complementary vendors*, such as Google, with whom it is co-developing university programs to teach the requirements for developing for new, open, cloud-based environments;

- *Professional organizations*, such as ACM with whom it adapts IBM courses in accordance with ACM curricula; and

- *Industry consortia*, such as the Service Research & Innovation Initiative, to which competitors including HP, Oracle and Microsoft belong.

But for all the help that IBM provides universities through access to free hardware, software and courseware, the greatest value is arguably provided by the company's 4,000 University Ambassadors. These ambassadors, who come from all parts of IBM, are often domain experts. They seek to engage and stimulate the passion of faculty members, help them tailor courses to real-world needs, and seamlessly weave IT and related disciplines into the fabric of these curricula.

Although the company has a core of about 400 ambassadors that focus full-time on University engagements, the vast majority of its ambassadors are volunteers that have full-time assignments in other fields. These part-time ambassadors may consult with professors around particular technologies and course designs, engage with individual schools, or teach courses at partner universities. Close to 800 of these people, for example, serve as adjunct professors or lecturers.

Evolving Focus

Although the primary focus of IBM's university program is skills development, the program actually has three primary legs:

1. *Skills development*, particularly around IBM products and key technology trends (such as SOA and cloud);

2. *Research*, as where IBM Research or product groups enlist and fund professors and graduate students around R&D initiatives such as cloud computing, high-performance computing and SOA; and

3. *Recruiting*, in which IBM attempts to identify particularly promising students and recruit them for careers at IBM.

While most of IBM's university programs are targeted primarily around IT initiatives, it has adapted many of its courses for use by business schools. Its INNOV8 BPM game, for example, is targeted primarily at business professionals and students, rather than IT. The company also engages with and funds professor research in areas ranging from mathematics (such as in advanced simulation and modeling), business (as around disciplines like supply chain management and new business models and practices), physical sciences (in areas ranging

from pandemic tracking to solar cell development) and social sciences (such as psychology and economics).

Section Two: The Growth of Interdisciplinary Education Initiatives

Although IBM has reaped big rewards from its traditional university efforts the company recognizes that market needs and industry requirements are changing. For example:

- Customers are increasingly demanding that IT solutions deliver true, demonstrable business value;
- Services is becoming the dominant sector of most country economies and is creating new opportunities to create "service systems" that make these services more repeatable, reliable and efficient;
- The number and percentage of developed-country students that major in technical disciplines, such as science, technology, engineering and math (what we collectively refer to as STEM), is declining, while those in emerging countries is growing; and
- Technological advancement is continually changing the requirements of knowledge work, as by increasingly automating some traditionally manual tasks (such as application development) and by providing tools that enable new skills (such as statistical modeling of Web traffic and data analytics).

New Skills Requirements

IBM is responding to these changes in multiple ways. It is increasingly linking its technology to pressing business and societal needs (as with its Smarter Planet initiative), focusing more work on tools to enhance services functions (as with its work on Service Science, Management and Engineering, or SSME), changing the way it presents technical information to students (as in using Smarter Planet to show students how they can apply technology to make a difference in their chosen field and in society) and expanding its engagement with universities in emerging countries.

These initiatives require increasingly interdisciplinary, T-shaped people—individuals that combine critical thinking, creativity and innovation with leadership, global awareness and technology literacy. IBM, therefore, is urging and helping universities move beyond traditional silo-based focuses—where they seek to educate and graduate specialists—to actively encourage and support truly integrated courses of study.

Students, for example, must have a deep understanding of specific industries or business processes, along with software engineering skills to create effective service systems. They must understand Web-based design and statistical modeling to tune Web-based delivery systems to the particular needs of individual customers. They must, however, understand these not as discrete disciplines, but understand how to use the tools of one discipline to address the needs of the other.

IBM also hopes and expects that the benefits that can be delivered through initiatives such as Smarter Heath Care, Smarter Cities and Smarter Food Systems will inspire aspiring healthcare professionals, urban planners and biologists to study the type of IT and mathematics disciplines that will be required to deliver on Smarter Planet promises. Such combinations, IBM claims, will allow graduates to address pressing needs within their own communities, such as by helping to create safer, more efficient healthcare and transportation systems.

IBM as Academic Catalyst

IBM built its first major cross-disciplinary university initiative around Service Science, Management and Engineering. It is currently working with more than 250 universities worldwide to design courses that combine disciplines including computer science, operations research, engineering, management science, business strategy, and social and cognitive sciences. While many of these 250 schools currently support SSME courses and, increasingly, full curricula and degree programs, about 40 have gone much further. Schools including Carnegie-Mellon, MIT and North Carolina State have created truly integrated curricula and inter-departmental SSME research initiatives in which management, engineering and related academic disciplines are focused specifically on enhancing services processes.

Smarter Planet has even greater interdisciplinary requirements. For example, IBM is currently helping universities develop “Smarter City” curricula that combine disciplines including business, IT, civil engineering and urban planning. It is similarly helping them develop courses to educate students to apply sophisticated analytics to all types of business needs, from protein folding to supply-chain optimization. IBM may work directly with professors to build such program. It may also work indirectly, for example, by funding the work of a professor that is looking to create a course around medical records management, by providing access to IBM Global Business Services medical consultants or by inviting IBM partners and/or customers to help in course design and/or delivery.

Developing courses and curricula, however, are only steps toward IBM’s real goal of helping universities create truly integrated, truly interdisciplinary Research Centers, in which professors and leading students from multiple disciplines come together to jointly address broad, real-world needs. Some, such as University of Arkansas’ Radio Frequency Identification (RFID) and Supply-Chain Optimization Research Centers, are aligned closely with specific local companies (in this case Wal-Mart). Others, like the University of Michigan's transportation center and University of San Diego's water management center focus on the needs of industry clusters and regions. Others, such as Carnegie-Mellon’s cybersecurity and MIT’s nanotechnology research centers, tend to focus on broad, cross-industry, foundational technologies. All, however, engage professors and students with companies and governments looking to address pressing, real-life needs.

Although most such efforts are focused on helping multiple groups within individual universities to address common needs, some of these initiatives span multiple universities. Some universities, for example, may partner in developing courses or research centers and many of the courses that are developed under IBM grants are available to other universities. Such collaboration can also cross borders. For example IBM is helping to connect faculties of developing-country universities with those of counterparts in developed countries that are working on similar issues, such as in energy management and food production.

Creating a Win/Win/Win

Such efforts have the potential of helping all parties. They can, for example:

- Help professors and universities better tailor their curriculum and research to real world needs;
- Provide students with more practical, real-world training and give them a chance to learn from and intern with potential employers; and
- Allow corporations to gain access to more students and build a larger pool of qualified talent from which they can recruit.

And don't forget the benefits these efforts deliver to IBM. It allows the company to engage more closely with multiple departments, capture the attention and imagination of professors, get more students trained on IBM products and burnish IBM's reputation as a thought leader and potential employer. It can, in other words, help IBM achieve all four of its Academic Initiative goals—develop skills that will be required by IBM and its customers, improve IBM's recruiting position, spur universities to conduct research around IBM initiatives and, thereby, indirectly help "sell" IBM Smarter Planet offerings by lending credibility to and adapting IBM solutions to the needs of its customers.

Section Three: Employee Recruitment, Development and Training

For all the benefits that IBM's Academic Initiative delivers, the most direct, and most immediate, are in providing IBM with a large stream of potential employees with the skills that IBM requires.

Recruitment

As mentioned, IBM leverages its university engagements to identify, engage and, in the case of internships and fellowships, "test drive" students for potential employment. It assesses candidates on the basis of factors including foundational competencies (including communication skills and teamwork), breadth of interests and contextual capabilities (the horizontal part of the "T-shaped skills), intellectual curiosity and, of course, specialized training and aptitude for the particular job for which they are being hired (the vertical part of the "T"). These jobs typically fall within one of six categories (see Figure 1):

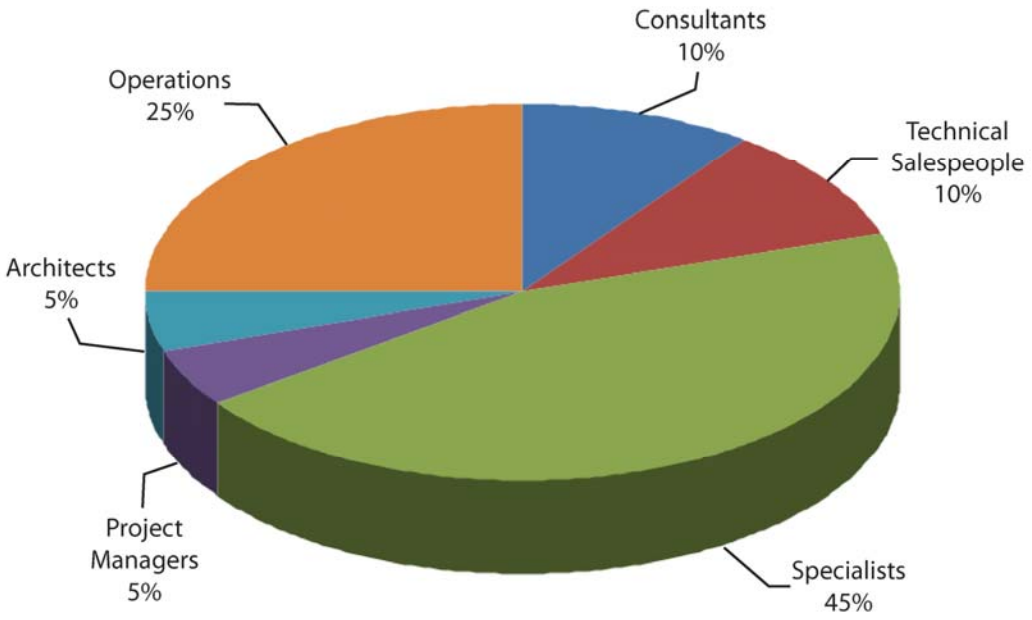
1. Consultants, who account for about 10% of IBM's 400,000-person workforce, model business processes, identify customer objectives and priorities, and build value propositions around customer objectives;
2. Technical salespeople, about 10% of its workforce, show clients what is required to achieve these objectives;
3. Specialists, about 45% of its workforce, provide in-depth skills in all types of disciplines. Roles may include programmer, software engineer, data analyst, call center agent, scientist and so forth;

4. Project managers, about 5% of employees, align and manage the resources required to deliver solutions to customers;

5. Architects, about 5% of the workforce, work with consultants and technology salespeople at the beginning of the process to define solutions, and then with project managers and delivery specialists during the implementation phase, to ensure that the project delivers the intended benefits; and

6. Operations people, the remaining 25% of employees, with roles including financial analysts, lawyers and administrators.

Figure 1: IBM's Entry Employee Hiring by Role



Source: Beyond IT, Inc. (based on information from IBM)

Employment Development

Once IBM employs these recruits, their real education begins. IBM has hired an average of about 40,000 people annually over the last five years and is dedicated to employee development. Every one of its 400,000 employees has a career framework, with milestones and goals tailored to their unique roles, skills and objectives, and IBM spends about $600 million (about $1,500 per employee) per year helping employees develop to their potential.

Every employee who enters the company or a new job is provided a skills taxonomy that outlines the requirements for success in each of the company's 350 "job roles" plus the requirements for progressing up through five competency levels (from "entry" through "thought leader") for each of these roles. They are then provided self-assessment tools to determine which skills they most need to develop (an assessment which is verified by the employee's manager and peers) and the company's Learning@IBM Explorer application that lists all of the learning assets (text, virtual classes, seminars, etc.) available to develop the skills on which they wish to focus.

Each employee can also select among different career tracks. Those who enter the company as specialists, for example, may choose to continue as specialists, progressing up through thought leaders in their current specialty or switch to another specialty. Those looking for new technical challenges can move to an architect track and those looking for more of a business focus can move to the consultant, project management or sales tracks. The company also provides a skills assessment tool that recommends the capabilities required for a chosen track and the learning assets that can best help the employee prepare for this track. IBM has also expanded its mentorship program to help guide employees through career choices and has implemented a cross-border mentoring program (to provide growing market employees with adequate access to mentors in developed markets) and a virtual Facebook mentoring program (which is now being made available to students, as well as IBM employees).

IBM also has a program to help employees who are not sure in which direction to take their careers. The online "Blue Opportunities" application allows employees to register for temporary or part-time openings in other departments across the company, so they can try a new career path before they commit to it.

Changing Development Priorities

Although IBM looks for a range of attributes in new employees, as mentioned, intellectual curiosity and commitment to lifelong learning are becoming increasingly critical for all IBM employees. The company, after all, is in the middle of two fundamental transformations:

- From a vendor of hardware, to one that is focused overwhelmingly on services and software; and
- From a vendor of IT solutions to one of business solutions that are tailored to the needs of specific industries.

These new focuses increasingly require that IBM employees understand the nature and needs of specific industries, how value is created in these industries and how IBM products and services can be best applied to deliver this value. This requires entirely new sets of skills. As mentioned, employees must have T-shaped perspectives to understand how specific technologies can best be applied to deliver maximum value to a particular company in a particular industry. IBM, therefore, has adapted its assessment programs and learning assets to help employees develop T-shaped skills, has expanded its use of cross-functional teams and has more than doubled its investment in industry-specific learning assets.

And since experiential learning is so critical in the learning of industry needs and the crafting of compelling, industry-specific value propositions, IBM is increasingly providing such opportunities as through the use of scenario-based tools and serious gaming (including INNOV8), expanded

mentorship programs, assigning projects on the basis of industry and by providing more opportunities for employees to work with experienced employees (from across multiple disciplines) on customer engagements.

Balancing Personal and Corporate Objectives

The company is also providing a greater range of more rewarding opportunities for employees to pursue their own personal objectives—even when these may provide limited direct value to IBM. Examples include:

- Personal learning accounts, where IBM matches 50% of employee contributions of up to $1,000 per year. Employees can use the money to fund whatever type of education or training they wish, including preparing for jobs in other industries or companies; and

- Corporate Services Corps, in which IBM supports the desires of high-performance employees (400 employees from thousands of applicants for the most recent assignments) to help other people and learn to thrive in a global economy by sponsoring multi-country, multi-disciplinary teams to perform community-driven economic development projects in developing countries.

While some IBM employee development programs provide opportunities for personal—as well as professional—development, most of its efforts are intended to deliver demonstrable business results. Consider, for example, its self-assessment tools. In addition to guiding employee development efforts, these tools also provide IBM with a detailed employee skills inventory which it uses to determine near-term project staffing requirements and long-term corporate needs assessments. IBM's Professional Marketplace tool uses this inventory to help managers staff projects. The manager defines the types of skills required, project duration, location and budget requirements and the application identifies potential combinations of employees with appropriate skills, available time, appropriate billing rates and so forth.

The company uses similar tools to plan for long-term staffing needs, to assure that IBM has an adequate pipeline of people to address future needs by recommending hiring priorities, training assets and career paths required to meet future needs.

Section Four: Implications and Opportunities

IBM's investments in universities and in its employees deliver direct, demonstrable benefits to at least four constituencies (professors, students, universities, IBM employees and IBM itself) and indirect benefits to at least two others (IBM customers and partners).

Academic Initiative Payoffs

Figure 2 summarizes the academic advantages which have been discussed throughout the report. They include not only the direct benefits to Academic Initiative participants, but also the indirect benefits to IBM customers and partners.

Figure 2: IBM's Academic Initiative Benefits Six Constituencies

Participants	Benefits
Professors	• Helps them tune their courses to evolving market needs • Provides them with access to required tools, domain experts and new learning techniques • Funds courseware development and research initiatives
Students	• Provides them with the type of skills that are likely to directly lead to challenging, high-paying jobs • Provides tools that allows them to learn in new ways • Opportunities for scholarships, fellowships, internships and permanent jobs
Universities	• Helps them create differentiated curricula that will prepare students for desirable jobs and expose them to potential employers • Encourages and funds research in promising new fields, some of which may offer commercialization opportunities • Facilitates linkages with private sector companies (including IBM partners and customers) around real-world needs
IBM Employees	• Prepares them for higher value jobs within IBM and facilitates assimilation into the IBM culture • Provides them with increased opportunities and tools with which to plan their own careers • Helps to instill the type of adaptability required to adapt to changing future employment needs
IBM	• Provides and gives IBM preferred access to students trained in disciplines that IBM requires • Enhanced engagement with institutions that can conduct independent research in and lend credibility to IBM initiatives • Establishes relationships that can help IBM better understand and more effectively sell into government, one of its most promising growth markets
IBM Customers	• Provides IBM with the resources to help customers reengineer and transform their own processes • Provides a pool of graduates that are trained in the application of IT to business needs • Provides opportunities for tripartite (customer, university, IBM) partnerships in the training of students around specific customer requirements and customer-directed research projects
IBM Partners	• Indirectly expands partner sales opportunities by increasing exposure of promising IBM market initiatives • Provides a pool of graduates that are steeped in IBM's highest-profile initiatives and underlying technologies • Facilitates synergistic linkages, as through university research centers, with professors, students and potential customers

Source: Beyond IT, Inc.

Although these benefits are indirect, and admittedly secondary to IBM's initial goals of preparing students for careers in the IT industry, these indirect customer and partner benefits will become increasingly pronounced as initiatives such as SSME and Smarter Planet gain more market traction and customers begin to implement them.

Competitor Implications

But what implications do these programs have for IBM competitors? First of all, let me be clear: None of these efforts are unique to IBM. Every technology vendor, of every size, has its own employee development and training programs. Most large companies have extensive, active university relationships that include many of the same components as IBM's. IBM's program, however, has a couple of important differentiators:

1. IBM's emphasis on more holistic T-shaped skills, and its work with universities to integrate IT skills more seamlessly into all academic disciplines, promises to produce people who value and understand how to use IT as a tool in producing business value;

2. Its big SSME initiative has the potential of transforming and dramatically improving the efficiency and productivity growth of the service processes that constitute about 70% of the GDP of developed country economies; and

3. IBM's expansion of its efforts beyond IT skills into business skills, and especially its alignment of university program with its Smarter Planet initiatives, allows it to reach far more students than competitor programs.

The second and third factor, in particular, have the potential of delivering huge benefits to IBM, and indirectly, to its customers and partners. Both, after all, are intent on systematizing, componentizing, automating and adding intelligence to the types of stale infrastructures and processes on which all companies and countries depend for growth.

One of the greatest long-term benefits of IBM's university initiatives, however, is likely to come from applying IBM Smarter Planet perspective (that virtually every system can be enhanced by reengineering and adding intelligence to it) to university curricula.

As discussed, the percentages and absolute numbers of developed country students with concentrations in STEM-related disciplines has been steadily declining. Although IBM, along with its competitors, is certainly attempting to make these technical courses of study more attractive and rewarding to students, IBM is doing something more. It is attempting to reach out to students (via their professors) across virtually all disciplines, as by:

- Demonstrating the value that IT-related skills can deliver within their specific specialty, and how these complementary skills will improve their employment and career prospects; and

- Improving the overall image of IBM among all students by demonstrating IBM's commitment to addressing the types of social and environmental causes that are important to the students, as with Smarter Cities, Smarter Energy, Smarter Food and Smarter Transportation.

Those students that recognize the value of applying technologies to their disciplines may learn from IBM instructors, use IBM courseware, learn to use IBM software and may receive fellowships or internships from IBM. Even if these people do not work for IBM, they are more likely to have a favorable impression of the company, have a predisposition for IBM products (on which they learned) and perhaps even favor working with the company, relative to its competitors.

The benefits attributable to engaging students around shared social and environmental values are much more abstract and speculative. These students, however, will end up working somewhere. Many will have at least an indirect voice in influencing how their company, their government body or their NGO spends its money. IBM has a potential of benefiting from any type of pre-disposition these people may have toward IBM.

Emerging Mandates

What does this all mean to other companies? First, there are always lessons to be learned from the practices of any company, especially from those that do so many things right. Second, and more importantly, all companies must face the declining interest in STEM by developing country students. These companies must increasingly reach beyond the declining pool of STEM graduates to ensure the availability of people required to fuel their own growth.

Just as importantly, they must also ensure an adequate supply of employees for their customers and their partners. As I continually emphasize in my blog, customers require not only trained IT people, but also businesspeople who understand how to apply IT to gain business value, and who are gaining growing control over corporate budgets. If companies have insufficient numbers of such people, their appetite for IT will decline. Worse still, if these businesspeople have been trained on a competitor's products and are predisposed to working with that vendor, a growing share of the customer's wallet will go to that vendor.

Partners, meanwhile, will face the same challenges as vendors themselves, except more so. After all, the largest employers—and those with the most powerful brands and that offer the most attractive career opportunities—typically get first choice of the best recruits. Smaller partners must share what is left over with their customers. Partners who cannot attract sufficient numbers of technical employees—especially those trained on their vendor's technologies—will suffer. Partners who cannot attract sufficient numbers of employees who understand—and can show customers—the value that technology can deliver to their customers' business; will be in even worse shape.

All vendors, therefore, must increasingly reach out to students beyond their traditional core STEM constituencies. They must engage students not only around the merits and use of their tools, but also around the value these technologies can deliver to the student's particular field of interest, whether that field is consumer entertainment, biology or art.

This will be a particular challenge for vendors that focus overwhelmingly on IT-based (rather than broader business-based) value propositions and those whose academic programs focus on teaching specific technologies (rather than broader business applications of IT). After all, while technical professionals will continue to play a vital role in the global knowledge economy, they will be far outnumbered by other professionals who are less interested in the inherent virtues of technologies, than in the ways in which technology can enrich their jobs and their lives. And, as we are already seeing, these professionals will continue to gain greater control over larger portions of corporate technology budgets.

Reports by Author Tom Kucharvy

2009

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- IT Solution Vendors' Three Big New Growth Opportunities

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- The Future of IT-based Offshoring: India's Changing Role
- The Foundations for a Knowledge Services Offshoring Economy
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These and a broad range of additional issues related to the jobs and the workforce of the 21st century are continually updated in Tom Kucharvy's blog.

Beyond IT: Strategies for Managing in a Global Knowledge Economy

Developed countries have mostly migrated from economies based upon manufacturing products to producing services—increasingly knowledge-based services. Now developing countries, led by China and India, are rapidly heading in the same direction. Every individual and every company that hopes to prosper in this new world must understand how to most effectively compete in the new global knowledge economy (GKE).

Beyond IT is a market strategy and consulting firm that helps companies manage the transition to a global knowledge economy by:

- Helping IT vendors identify and prioritize emerging GKE opportunities and challenges and leverage their existing skills into value propositions that transcend IT to deliver broader business value to their customers and clients; and
- Providing all companies with single-source access to emerging best practices around the requirements for managing workforces, innovation and corporate social responsibility in a GKE.

Through reports, webcasts, workshops and consulting, we:

- Identify the key components of a global knowledge economy and why GKE is becoming a business mandate for virtually all companies;
- Explain why IT vendors are so well positioned to capitalize in a GKE and how they can most effectively leverage the experience gained from their own GKE initiatives into new revenue streams and more strategic client relationships;
- Identify emerging trends and best practices that companies can utilize for building their own successful GKE strategies;
- Assess the new opportunities for capturing and deploying innovation in a GKE; and
- Examine how a global business needs to balance its business requirements with corporate social responsibility.

Beyond IT's founder and author of this report is Tom Kucharvy a 30-year IT industry analyst veteran with an impressive record of anticipating trends—and helping clients drive and prepare for industry-shaping change. Whether or not you agree with Tom's out-of-the-box thinking, his honest, objective analysis is guaranteed to open your eyes to new possibilities.