

Knock, Knock, Knocking On Newton's Door

Building Collaborative Networks for Innovative Problem Solving

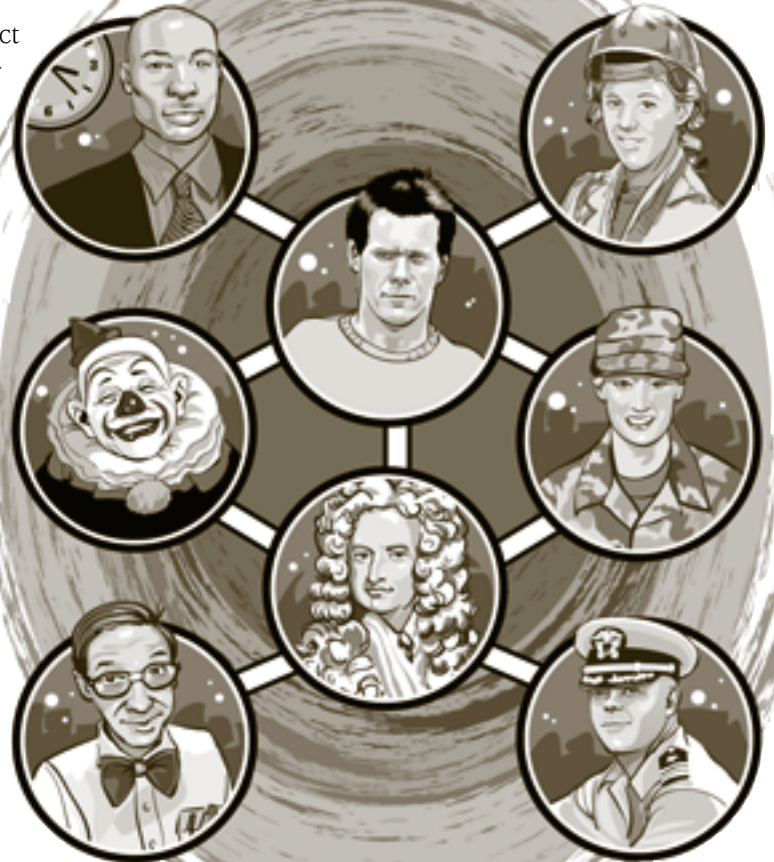
Maj. Dan Ward, USAF

In 1684, astronomer Edmund Halley and architect Sir Christopher Wren were wrestling with a mathematical proof for explaining planetary orbits. They asked the esteemed natural philosopher and inventor Robert Hooke for assistance, but Hooke was unable to provide the requested solution. Halley then visited Isaac Newton, who claimed to have solved the problem years earlier. Unfortunately, the disorganized genius couldn't immediately find the papers, so Halley left empty-handed.

Some three months later, Newton sent Halley a nine-page treatise containing the elusive proof. At Halley's request, Newton revised and expanded the short paper, and after another 18 months, it filled the three volumes we now know as *Philosophiæ Naturalis Principia Mathematica*. The *Principia* firmly established Newton as one of history's greatest scientists, but it is not clear whether Newton would have produced this magnificent opus without Halley's urging. It makes one wonder how many other scientific and technological breakthroughs throughout history were delayed or undiscovered because there was no Halley to knock on Newton's door.

Desperately Seeking Newton

Similar situations exist today, in academia as well as the defense acquisition, technology, and logistics community. Program managers, engineers, and logisticians wrestle with many challenges, technical and programmatic, that have already been solved by others who would be willing to share their solutions—if asked. Some of those “hidden Newtons” live and work in commercial or scholastic arenas, while others are government and military personnel. And some, undoubtedly, are still in high school. The challenge, therefore, is to locate and engage experts with rele-



The challenge is to locate and engage experts with relevant—often non-obvious—skills, experiences, and knowledge that could help us solve the problems at hand.

Ward, now assigned to the Air Force Research Lab in Rome, N.Y., once shared an office with Capt. Chris Quaid, USAF, who is a cousin of actor Dennis Quaid, who was in The Day After Tomorrow with Jose Ramon Rosario, who was in Mystic River with Kevin Bacon. Small world indeed!

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This centuries-old challenge merits a close look today for at least three reasons. First, despite our best efforts, no one has really solved it yet. Even denizens of cyberspace often find it challenging to identify and connect with potential collaborators. Second, academia is finally beginning to seriously study the structures and functions of networks. Understanding how networks work is key to figuring out how to establish the connections we seek, so this new realm of academic investigation is likely to produce useful insights and answers. The third, most obvious, reason is the increasing ubiquity of the Internet and other network-establishing technologies.

Hungry Physicists and Lots of Bacon

Social psychologist Stanley Milgram performed his famous “small world” experiment in 1967, concluding that everyone on earth is connected to everyone else by no more than six people (if I may oversimplify his results a bit). This led to the party game “Six Degrees of Kevin Bacon,” where players try to establish connections to the esteemed actor in the least number of jumps. (Check out the University of Virginia’s <www.oracleofbacon.org> for one example.) Naturally, formal academic investigations soon followed, the initial results of which are nicely documented in the book *Six Degrees: The Science of A Connected Age* by Columbia University sociology professor Duncan J. Watts.

In this highly readable book, Watts explains how sociologists, mathematicians, physicists, and experts from other disciplines converged to explore the new field of networks and “small-world” models. He gives physicists much of the credit, explaining: “The arrival of physicists into a previously non-physics area of research often presages a period of great discovery and excitement. ... No one descends with such fury and in so great a number as a pack of hungry physicists.”

The story of how this academically diverse group of people came together is itself an enlightening example of how networks function, but the group’s actual output is where the money’s at. Watts’ list of further reading exceeds 30 pages, to which the bibliography adds another 12, an impressive output indeed for such a new field of study.

Large Tents and Small Worlds

Why does this matter? Let’s return to Halley and Newton and the persistent challenge of establishing connections between people to facilitate problem solving. That is the point, after all. Centuries before Linus Torvalds (creator of the Linux operating system) opined that “given enough eyeballs, all bugs are shallow,” Edmund Halley understood

Curiosity Nourishes the Cat

As well as the books and Web sites mentioned in the article, curious readers may be interested in the following:

- *The Cathedral and the Bazaar*, Eric Raymond: Explores two software development approaches, one of which (the “bazaar”) is strongly network-centric
- *The Medici Effect*, Frans Johansson: Shows how innovation often results from cross-pollination between intellectual and experiential domains
- *Tipping Point*, Malcolm Gladwell: Explains impacts of social networks, from fashion trends to epidemics
- *The Wisdom of Crowds*, James Surowiecki: Explains why “the many are smarter than the few,” and how group intelligence can be greater than the sum of the parts

the value of collaboration—hence his entreaties to Hooke and Newton. Echoing Halley’s experience, Watts offers an assessment—and a warning—for modern organizations in terms Halley would certainly agree with: “Firms that are bad at facilitating distributed communications are bad at solving problems, and therefore bad at handling uncertainty and change.” Watts goes on to explain that “rapid access to everybody else’s work ... dramatically speeds up the cycle of ideas and innovation.” It certainly worked for Halley.

The DoD is currently in a time of great uncertainty and change, not only in terms of the global war on terror, but also because of the continuing information technology revolution. Rapid innovation and an accelerated “cycle of ideas” are clearly called for. *Six Degrees* offers insightful guidance to help smooth the path forward.

Along with explaining how networks function and contribute to innovative problem solving, Watts offers some specific advice. He writes: “A good strategy for building organizations that are capable of solving complex problems is to train individuals to react to ambiguity by searching through their social networks, rather than forcing them to build and contribute to centrally designed problem-solving tools and databases.” Such informal networks are able to bring to bear intellectual resources that would otherwise be excluded, creating a somewhat paradoxical situation I call Large Tent/Small World. An LT/SW approach is both widely inclusive (LT) and well-connected (SW). Unfortunately, many DoD enterprises tend towards centrally designed and controlled structures, not the more flexible, responsive approach advocated by Watts. An exclusive, isolated (Small Tent/Large World) framework makes distributed communication difficult and is less than optimal for innovative problem solving.

In his book *Smart Mobs*, Howard Rheingold makes a related point, observing: “The Web spread by infection, not fiat.” Here again, the DoD—like many other bureaucracies—has a tendency to inoculate against such “infections,” rather than allowing them to spread and grow as the Web has. There are some legitimate reasons for doing so—security and accountability, to name just two. But perhaps flexibility and security are not mutually exclusive. The continued growth of the Web will make it difficult, if not impossible, to insist on centrally designed, fiat-driven approaches. Whether we are ready or not, the tent is growing and the world is shrinking, and while that creates some new challenges, it is ultimately a good thing.

Our Mission, Should We Choose to Accept it

The task of establishing fruitful connections between people and groups is not an easy one, but time spent addressing the challenge is likely to pay off in spades. There are four areas of activity PMs can pursue as they seek “to locate and engage people who have relevant knowledge.”

Area A: Understand networks

This is the intellectual, academic area, and at times it may feel like homework, but hang in there. Along with *Six Degrees*, readers may want to check out the books recommended in the sidebar on the previous page. These resources help explain the structure, functions, limitations, and utility of networks, and they provide an intellectual foundation upon which to build. And for the most part, they’re actually pretty good reads. Understanding what networks are and how they work makes it easier to create them and use them to our advantage.

Area B: Foster curiosity

This is the most personal, character-oriented dimension. The more curious a person is, the more likely he or she is to search widely for information and establish a large network of partners. PMs can encourage curiosity in many ways—by hiring for it, encouraging it, valuing it, and at the very least, by not squooshing it—but ultimately, curiosity is an internal quality of a person’s character. It’s probably not possible to force someone to become curious. Fortunately, there is something universal about it. Einstein said it’s a miracle curiosity survives formal education, and yet it usually does. It’s unlikely curiosity can be either created or destroyed, but by their words, actions, and priorities, PMs can certainly encourage or discourage it. Wise PMs foster it at every opportunity, di-

recting this innate human attribute towards the team’s particular challenges.

Further, curiosity and creativity tend to be linked. This means not only are curious people usually well connected to a diversely populated network, but they also tend to have a greater aptitude for creative thinking and problem solving ... but that’s a topic for another day.

Area C: Facilitate connections

This is the most formal, organizational dimension. Mentorship programs are one official way to facilitate connections that may not develop otherwise. Similarly, unit fitness programs, professional conferences, and other informal environments can bring people together in interesting ways. In the commercial world, the Web site <www.friendster.com> seeks to connect people through

mutual friends who act as connective nodes—an interesting model for the defense community to consider. And speaking of dot-com, the Internet itself is a wonderful way to find, engage, and collaborate with people from around the world—just ask Linus Torvalds and the Linux community.

In *Smart Mobs*, Rheingold explains: “When a network is aimed at broadcasting something of value to individuals, like a television network, the value of services is linear. When the network enables transactions between the individual nodes, the value is squared. When the same network includes ways for

the individuals to form groups, the value is exponential.” Similarly, the more opportunities an individual has to create and join groups (particularly informal groups), the more he or she will be able to contribute to a problem-solving endeavor. In the words of my former officemate, Air Force Capt. Chris Quaid, “Networking is working.”

Area D: Pursue intellectual diversity

We all know the old saying about how every problem looks like a nail if your only tool is a hammer. Similarly, a room full of engineers is likely to produce an engineering solution to whatever problem they are given, and sometimes an engineering solution is not actually needed. A well-placed psychologist, marketer, mathematician, or circus performer may bring a much needed fresh perspective and fresh solution to problems, old and new. For all the weaknesses of matrixed organizations, one good thing they often did was create a diversely skilled team.

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Few of us have the ability or authority to hire new people onto our teams, but that is the beauty of informal networks. They function best when the connections are loose. A person need not be an official member of the team to contribute significantly. As Watts explains, it is often the case that "important innovations originate not in the core of a network but in its peripheries." The trick is to pursue and engage those peripheral connections.

The Newton Network

The challenge of building collaborative communities is as old as humanity itself, and it is unlikely to be solved in a magazine article. There is no quick fix here, and following these recommendations will undoubtedly lead to new challenges. Some people will not want to help. Some will give wrong answers. Some will try to eat your lunch. And some will probably be spies. People are funny that way, and no one said this would be easy. But the beauty of a Large Tent is it likely includes some people who are willing and able to help... and a Small World makes it easier to connect with them. The essential first step in pursuing a LT/SW approach is to understand how networks function and then use that knowl-

edge to begin breaking down organizational stovepipes and geographic/academic/professional barriers.

The optimal solution would be a whole network of Newtons, each highly competent in a particular field, each firmly dedicated to collaborative, innovative problem solving, and each connected to everyone else by no more than six degrees. The IT revolution has provided a host of new technologies that make it easier to establish these networks, from chat rooms and blogs to cell phones and BlackBerry® devices. Duncan Watts' book (and others) provide much of the necessary foundation. It is up to us to do our homework and start knocking on some doors.

Networking is working.

Capt. Chris Quaid, USAF

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The author welcomes comments and questions. Contact him at daniel.ward@rl.af.mil.

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