Bridging Small Worlds to Accelerate Innovation

Carderock Naval Laboratory Pilot

Gary Markovits ▪ Devin C. Markovits ▪ Joseph P. Teter

The President's Council on Competitiveness defines innovation as the ability of an organization to deliver a continuous stream of relevant products and services to its customers; and according to the National Innovation Initiative, innovation is the "single most important factor in determining America's success through the 21st century." But our nation and the defense industry are facing an innovation gap. Driven by the complexity, uncertainty, and pace of world events, the demand for innovations is outstripping our ability to provide them. To close the gap and meet demand, we must innovate smarter not harder.

The Myth of the Lone Inventor

Innovation can be seen as a progression of inventions, each solving the next in a series of challenges and moving the initial innovative idea one step further from mind to market, from concept to product. So the solution seems simple. We must invent solutions faster. And if we need more invention, let's just hire more inventors.

But where do we find more of those eccentric and prolific lone inventors? How do we recruit and hire the likes of a Thomas Alva Edison, a Henry Ford, a Leonardo da Vinci, or an Albert Einstein? The answer is we don't. Why not? Because the "lone inventor" is a myth.

Henry Ford has been credited with having invented mass production and with it introducing the Model T, a "car for the masses" that changed the course of our nation and energized the American economy. But a closer examination of history reveals that Ford didn't go off in a corner by himself and rack his brain giving birth to the concept. Rather, Ford's mass production was a new assemblage of existing concepts. Ford borrowed the ideas of interchangeable parts from firearms and sewing machine manufacturers, continuous workflow concepts from cereal and cigarette manufacturing, and assembly line concepts from the meat packing industry. After visiting Swift's Chicago meat packing plant in 1906, William Klann, head of Ford's engine department, is quoted by Andrew Hargadon in *How Breakthroughs Happen—The*

Gary Markovits *is founder and CEO of Innovation Business Partners. He developed the concepts of IP Driven Innovation™ to help R&D and engineering organizations increase their capacity for innovation.* **Devin Markovits** *is vice president of patent analysis for Innovation Business Partners and led the development of Akribis Search™, the natural language processing patent search engine used in IP Driven Innovation.* **Teter** *is the director for technology transfer at the Carderock division of the Naval Sea Systems Command, responsible for developing partnerships with industry to facilitate the transfer of intellectual property to and from the Carderock warfare center. He received his doctorate in physics from Temple University, Philadelphia, Pa.*

Surprising Truth About How Companies Innovate as saying, "If they can kill pigs and cows that way, we can build cars that way."

In a patent lawsuit over the invention of the automobile, Ford testified, "I invented nothing new. I simply assembled into a car the discoveries of other men behind whom were centuries of work. … Had I worked 50 or 10 or even five years before, I would have failed. So it is with every new thing. Progress happens when all of the factors that make for it are ready, and then it is inevitable. To teach that a comparatively few men are responsible for the greatest forward steps of mankind is the worst sort of nonsense."

Bridging Small Worlds to Build a Brave New Small World

Each of the industries Ford borrowed from represented a "small world" all of its own. And in general, each of the small worlds was isolated from the others. The meat packers didn't communicate with the sewing machine manufacturers who didn't communicate with the cereal processors. Ford's genius lay in bridging those small worlds to create a new "hybrid" small world for the auto industry. Ford hired key people—Walter Flanders from Singer Manufacturing Company and Max Wollering from International Harvester, for example. Wollering brought the concept of single-purpose tools to automobile mass production. "There was nothing new to me," Hargadon quotes him as saying, "but it might have been new to the Ford Motor Company because they were not in a position to have much experience along that line." The new science of networking would say that Ford was "bridging small worlds" and "reducing the degrees of separation." For an enlightening overview of the role of networking in innovation see "Knock, Knock, Knocking On Newton's Door," *Defense AT&L*, March-April 2005.

But doesn't this leave us with the same problem of finding key people and hiring them away from other small worlds? We can't always do that. Our budgets and other constraints won't allow it. So what are the alternatives?

Leveraging the World's Investment in R&D

Every year, the nations of the Organisation for Economic Co-operation and Development <www.oecd.org> spend over $500 billion on research and development. It is spread across every conceivable discipline and addresses a multitude of challenges. Over the years, these trillions of dollars spent on R&D have resulted in an enormous collection of inventions.

In recent years, more than half of the R&D investment has been made outside the United States. Fortunately for us, the United States is the world's largest marketplace, and because of that, any invention of any economic value, be it foreign or American, is filed in the U.S. patent system. So the U.S. patent database is more than a repository of the legal rights of inventors, it is a knowledge base of the leading-edge elements and relationships generated by all of the small worlds—the clusters of R&D—around the globe. Properly mined, the knowledge from the patent database can be used to bridge a multitude of small worlds, helping all of us invent solutions to the challenges of our own small worlds.

This is actually what the founding fathers intended when they implemented the patent system: In exchange for legal protection, the inventor had to publish his or her findings in a patent to "promulgate the arts and sciences." Even 200 years ago, the founding fathers understood how important it was to bridge small worlds and share knowledge.

Using Patents to Accelerate Innovation

In the fourth quarter of 2003, the Office of Naval Research decided to test this bridging concept using patent mining tools and techniques developed by Innovation Business Partners.

At the Carderock Naval Laboratory in Maryland, four teams were assembled. Each team consisted of five people selected from different organizations across the laboratory. Each team was given a different challenge. One team, for example, had to address corrosion, the Navy's single largest maintenance issue. Each team brought in experts to discuss its particular problem and define the challenge. The teams considered how others had attempted to solve the challenge, what the shortcomings of past solutions were, and what the attributes would be of an ideal solution.

Every Thursday for 10 weeks, the teams met separately for brainstorming sessions. Using Innovation Business Partners' very precise Akribis Search™ technology, the teams were fed "relevant" patents that came from other small worlds but addressed problems analogous to the Navy's. They analyzed the patents for the different elements and relationships other inventors had used to solve analogous problems, and they brainstormed how the same components might be used to solve their own challenge. These sessions never lasted more than an hour-and-a-half, and the intent was not to solve the challenge in the session, but rather to plant in the minds of the participants new elements and relationships and allow them to incubate over the weekend.

Every Monday, the teams held another brief meeting to harvest new ideas and refine the challenge in light of the new knowledge. The new knowledge was used to formulate the next round of patent mining and provide the patents for the following brainstorming session.

After 10 weeks, the pilot was complete. One measure of output was the number of invention disclosures. The 20

"1913 - Trying out the new assembly line"
By an unknown photographer, Detroit, Michigan, 1913. National Archives and Records Administration, Records of the Bureau of Public Roads

people produced 10 invention disclosures on a per capita basis—100 times the laboratory average for the previous year. Ideas that can't withstand the test of an invention disclosure review are worthless, but after passing that hurdle, the performance of the four teams was still 50 times the site average. And one year after the pilot, the processes introduced are still being credited with new inventions. Given the relationship between invention and innovation such dramatic increases in the rate of invention will accelerate innovation.

Denmark, Diapers, and Heart Pumps

The team addressing the corrosion challenge provides an enlightening example. In listening to experts and refining their challenge, they focused on the corrosion of pipes. Normally one might have expected them to pursue a pipe coating to inhibit the chemical reactions between the salty condensate that forms on pipes and the metal. However, this would still have left the Navy with the problem of the condensate dripping from the pipes. That problem is solved today with drip pans, buckets, mops, and a lot of sailors. But in tomorrow's Navy, there will be fewer sailors per ship for mop duty, so simply coating the pipes was not the ideal long-term solution.

What other small worlds have an analogous problem? In part, the answer came in the form of a set of Danish building patents. The environment in Denmark is such that Danish builders face similar problems in their homes, offices, schools, and hospitals. But the Danish solution was only 70 percent of what the team needed. The more extreme conditions on board ship require higher-performing materials that can wick away moisture without retaining any of it. It turns out this is a problem that has been thoroughly addressed in another small world—the small world of diapers. The team brainstormed a combination of the Danish building patents and modern diaper materials that produced a solution for 90 percent of the shipboard environments. However, there remained one extreme environment in which the solution would not work; that environment called for active removal of the moisture. It turns out this challenge is analogous to that of removing moisture from aortic heart pumps. In the end, a combination of the elements from the Danish building, the diaper, and the heart pump patents produced a total solution.

But the story doesn't end there. The team discovered that the Danish building patents had been licensed by a U.S. company that was manufacturing a product for hospitals and large industrial buildings. The team brought in a representative of that company, explained how their improved invention could address the maritime market, and initiated discussions to explore the possibility of the company's manufacturing the product for the Navy. In the end, the team estimated they had saved two years and $10 million in R&D costs. Not a bad return for three hours a week over 10 weeks.

Meta-ideas Close the Innovation Gap

In fact, during the 30 hours, the teams produced nine invention disclosures, three of which were filed as patent applications. This was an excellent return on investment, especially considering that the majority of the participants had no prior experience with the patent process. Long term, it can be reported that 53 percent of the participants are using the techniques learned in the pilot to continue to create intellectual property for the Navy. Several of the participants who had not previously worked on patents are now regularly submitting invention disclosures in the course of their duties.

Tools like those used in the Carderock pilot are known as "meta-ideas" (ideas that support the generation and propagation of other ideas). They are the "breeder reactors" of innovation, the tools that can help us close the innovation gap and generate more value for our customers.

In 2004, the Office of Naval Research conducted a second set of pilots to explore the use of meta-idea tools to define R&D investment strategies and rapidly identify commercial off-the-shelf solutions to urgent operational issues. Stay tuned—results of these pilots will be reported in future articles in *Defense AT&L*.

The authors welcome comments and questions. Gary Markovits can be contacted at gary@innovationbp.com, Devin Markovits at devin@innovationbp.com and Teter at joseph.teter@navy.mil.