

Something for Everyone: Building Incentives for Innovation Ecosystems

A paper by Edward Jung, Founder & CTO, Intellectual Ventures

INTELLECTUAL VENTURES®

Healthy innovation economies are the main driver of prosperity in the 21st century. But the three players that have traditionally sponsored basic research and invention in those economies are no longer willing or able to perform that role. Corporate R&D has become increasingly conservative as concerns for profit push incremental, rather than radical, innovation. Governments are de-prioritizing funding for basic, blue-sky research. The days of massive, government-sponsored science and technology projects, such as the Apollo program or the military microelectronics investment that spurred Silicon Valley, are well behind us.

Even venture capital, the favorite alternative for financing disruptive technologies, is stumbling. The risk-reward ratio for boot-strapping deep-technology startups is no longer acceptable to most investors. The model works only when innovations are relatively cheap to implement and there's a really large gain at the other end—a formula that is dependent on IPO market factors, interest rates and other externalities. Consequently, VC capital has fled from fundamental technologies such as semiconductors, optics, materials, medical devices and therapeutics and toward the next Instagram, Rovio or Facebook.

The startup model of innovation is insufficient to drive large-scale, long-term prosperity in any case. Even the most ambitious startup is necessarily constrained in the scale and scope of its mission. Meanwhile, the world is increasingly besieged by complex problems that cannot be solved by startup-sized solutions alone. These problems demand a coordinated effort among inventors, companies, industries, governments and finance mechanisms, all working toward useful innovation in a system that supplies incentives for all.

At Intellectual Ventures, we've had success with a model that's commonly called an Innovation Ecosystem. As the name suggests, these ecosystems consist of a many different kinds of participants interacting to produce and deploy valuable inventions. At its best, an Innovation Ecosystem creates an environment where all the parties involved in driving innovation can thrive: everyone from the lonely genius hatching a new idea to the investor looking for the next big asset class, from the cash-strapped government trying to power up economic development to the company that wants to move product into white space.

Innovation Ecosystems work because they provide something for everyone. The incentive structure of the ecosystem must be as varied as the participants themselves, recognizing their very different priorities and needs. While all participants get something valuable out of it, no two may get the same thing. It's no surprise that Innovation Ecosystems don't arise spontaneously; in that sense, they aren't "natural." But if you can create a system of incentives that appeal to scientists, engineers, investors, companies, governments, universities, research labs and so on, then you can draw these disparate groups together and cause their natural behaviors to move in a certain direction: toward collaborative innovation and mutual prosperity.

That is what we've been doing at Intellectual Ventures, both with our funds and with many new projects we've started on the strength of our experience with this model. The following examples illustrate how Intellectual Ventures uses incentives to build Innovation Ecosystems and what we've managed to achieve with them.

I. Intellectual Ventures

Intellectual Ventures was created to maximize the efficiency of assembling high-value portfolios of inventions in very diverse fields, including healthcare, energy, information technology and materials. It uses several funds and operating companies to supply and balance varying incentives for the thousands of different parties involved. In a sense, Intellectual Ventures exists to construct a new ecosystem that connects these parties and provides ways for them to interact to their mutual benefit.

Such an ecosystem is not just a good idea—it is a necessary one, given the way the relationships among innovating principals have degraded of late. For over a century, individual inventors and small companies were the backbone of American innovation. These players were able to talk directly to manufacturers about turning their inventions into products. Edison and Tesla, for example, had invention organizations that licensed their inventions to large companies such as General Electric or Westinghouse in return for R&D contracts and royalty agreements.

In recent decades, however, the incentives for inventors and large companies have become misaligned. Today's innovative products have become so complex and cycle so fast that many large companies have difficulty identifying the all potential sources of the inventions relevant to their business. Due to this uncertainty, they have also become less willing to pay royalties, and therefore most inventors have been shut out of conversations with the large companies that could be their best customers.

With its funds, Intellectual Ventures built an incentive structure that re-aligns the interests of inventors and companies. Its asset purchases provide short-term liquidity to inventors, allowing them to pay the bills and continue their R&D, often while offering them a percentage of future profits as well. The inventions Intellectual Ventures buys also become available to a global network of potential customers. Opportunities like these reduce the risk equation for inventors and provide them with powerful incentives to conceive and distribute new ideas.

To companies Intellectual Ventures provides organized catalogs of inventions and an ongoing survey of additional invention sources, all offered at a predictable cost. Intellectual Ventures can also organize acquisitions of new resources at scale and with multiple partners. The recent acquisition of Kodak's digital-imaging portfolio by Intellectual Ventures, for example, involved more than a dozen companies around the world. The opportunity to secure invention rights with greater predictability and scale acts a powerful incentive for a product company.

In this way and others, the incentive system Intellectual Ventures established with its funds has filled gaps in the innovation marketplace that prevented both inventors and companies from accessing resources they need to connect and innovate. So far, this system has provided more than \$400M in liquidity to inventors and tens of thousands of inventions to product companies.

Yet Intellectual Ventures' innovation system would not qualify as an ecosystem if it involved just these two types of participants. Beyond the thousands of inventors and many companies in its network, Intellectual Ventures also attracts billions of dollars of yield-seeking investors and long-

term investors, dozens of venture capitalists, hundreds of agents and brokers, a thousand subject-matter experts and hundreds of research organizations and universities all over the world.

It does so by balancing risk and reward for all its participants and by supplying the incentives they need to thrive. The careful design of incentive structures builds a functional and productive ecosystem of innovation.

II. Technology Reserve

Many organizations in industry and academia have more IP assets than they know what to do with. Sometimes the surplus IP is irrelevant to the focus of a company's product line; sometimes, as is the case with many universities, there is no efficient mechanism for technology transfer.

There are also many governments that want to expand their footprint in the global economy in order to drive economic development at home. Their small and medium enterprises (SMEs) are often hungry for ideas that would help them build world-class products. Many of these SMEs live off a single supply-chain relationship with a large manufacturer, and their economic fortunes rise and fall with those of their partner company. Breaking SMEs out of their dependence on such fragile supply chains would create value not only for their domestic economy but for customers elsewhere in the world.

Wherever there are complementary needs like these, there's an opportunity to build an Innovation Ecosystem. One such system is Technology Reserve, a structure incubated at Intellectual Ventures that is now an independent organization. Technology Reserve will enable owners of large portfolios of inventions to broadcast their intellectual property to SMEs all over the world while giving SMEs access to the inventions, know-how, support and financing they need to innovate on a global scale.

Through Technology Reserve, corporations can work with partner governments to market their invention portfolios to SMEs. Access to those portfolios is facilitated by targeted government programs that include potential subsidization of licensing fees for SMEs that decide to commercialize any of those inventions.

For the large owners of inventions, such as big technology, chemical or consumer-products companies, the incentive to participate in Technology Reserve isn't money up front. Rather, these companies benefit from their connection to a supply of SMEs that are willing to take on the risks of product development and to validate ideas in the marketplace. Large companies thus get to distribute the risk of innovating and then capitalize on the SMEs' success through acquisition or new product or supply-chain relationships.

The SMEs' incentive is more obvious: low-cost access to the best technology and technologists in the world, along with R&D support from government and large companies focused on their success. The sponsoring government joins Technology Reserve to drive employment and GDP

growth efficiently—through SME expansion, not just new company formation—without being forced to choose, fund or manage specific projects or lines of research.

Everyone benefits from such an arrangement. Yet no one participant in the ecosystem could have created a structure in which all these groups can profitably interact. Technology Reserve is uniquely positioned to coordinate the myriad incentives that motivate companies, governments and small- and medium-sized businesses. By aligning these incentives, it encourages the globalization of vital knowledge, partnerships, markets and opportunities and jump-starts the participation of regional innovation systems in the global economy.

III. Kymeta

Last year, Intellectual Ventures formed its latest spinoff, Kymeta, to commercialize a portable antenna technology for satellite communications that would allow users to access broadband signals on the move, from cars, trucks, trains, airplanes, boats or on foot. On its surface, Kymeta looks a lot like a typical startup: it's a small company formed around a single technology and product. But in many ways Kymeta is an “anti-startup,” because it came from a unique innovation environment that circumvents the shortcomings of the standard startup model.

Kymeta's antenna technology is a spin-out from Intellectual Ventures' decade-long program in metamaterials, a new class of synthetic materials engineered to have properties not found in nature. Scientists at Imperial College and Duke University discovered groundbreaking new applications for these materials more than a decade ago. Yet like the laser, which began as a nifty invention no one knew what to do with, metamaterials were all potential. The road to practical use and commercialization was far from clear.

Convinced of the eventual value of metamaterials, Intellectual Ventures created an ecosystem to explore and develop applications for them. It started with our relationship with investors who were willing to fund long-term inventions of diverse types. Metamaterials was actually just one of the areas we chose to focus on: we also invested in more than fifty other technology areas to match the risk profiles of our long-term investors.

To explore the commercial prospects for metamaterials, we brought scientists from Imperial and Duke together with scientists and engineers from research institutions such as MIT and Lawrence Livermore to brainstorm applications in areas as wide-ranging as healthcare, semiconductors, cameras and antennas. We acquired some of the fundamental IP and generated a lot more. We selected a few of the most promising application areas and worked with Intellectual Ventures Lab and other contract groups to generate working prototypes.

Then we connected our effort with a network of venture capital-like financial partners to fund and write a business plan for one of the applications. We also secured government grants for the concepts and industry demand-side funding from companies like Inmarsat, offering these participants high-technology solutions with deep backing to real problems.

The incentives in this ecosystem model are especially complex. For example, we had to grapple with the reality that venture-capital partners ordinarily lack the incentive to invest over the entire fifteen-year period our program stipulated. We aligned the VCs' priorities with our ecosystem by taking measures that diminished the risk of the investment: focusing on a specific application (antennas), prototyping that application in various laboratories including our own, validating the concept with demonstrable government and industry demand, finding a seasoned entrepreneurial CEO, and packaging the opportunity into an equity-based startup company.

By connecting the VCs' particular incentives with those of government partners, industry partners, long-term financial investors, university partners, labs and inventors in a sustainable, replicable incentive system, we were able to create innovation value.

And Kymeta is just the first of many spin-outs we plan to carve out of our sprawling effort in metamaterials. Our investment will produce more than just one company. The idea is to have a large enough body of IP in a given area to get multiple shots at developing applications that, like Kymeta's antennas, demonstrate strong potential for commercial success. Multiple shots lower the risk of investing in the technology and improve the chances that something of benefit to society will emerge from the research effort. This strategy also makes the twenty-year investment horizon palatable to long-term, non-VC investors.

And the ecosystem incentive model we demonstrated with Kymeta will support more than just the commercial development of metamaterials. We can use that model whenever we want to create and manage an incentive system that includes long-term investors, venture capital, university technology-licensing offices and academic and commercial inventors over a ten- or twenty-year horizon. It's a far more efficient way of doing disruptive innovation than the traditional technology startup, and it's a better way of investing in it, too.

It's important to note that this model only works at a certain scale. There's no way you can get all these incentives to work with just one set of inventors, one research group, one type of investor or one company. And it's unlikely that all the people needed to make this model work would ever meet, let alone work together, without the incentive structure Intellectual Ventures created. Our metamaterials ecosystem bridged a radical gap in the traditional systems for sparking, funding and commercializing innovation.

IV. TerraPower

Nuclear energy probably isn't the first area that springs to mind when you think about places that are calling out for innovation. The industry has a controversial reputation; it's bound by complex regulation; and it's guarded by powerful incumbents. Moreover, development of any nuclear alternative is too long-term for corporate investment horizons and traditional financing mechanisms.

That's why practically no one has heard about the many alternatives that exist for generating electricity from nuclear power. There is actually a range of promising options, including a concept for a self-fueling reactor that was proposed in the late 1950s. These alternatives were

the subject of decades of research at U.S. national labs. But despite the glaring need for clean, safe, and sustainable energy sources in both the developed and the developing world, industry stakeholders had no incentive to develop new kinds of reactors for power generation. Nor was anyone was foolish enough to build a start-up around such technologies.

Once again, Intellectual Ventures filled a gap in the incentive system. We built an ecosystem that encouraged nuclear physicists, engineers, corporations, investors and government representatives to work together toward a practical design for the traveling wave reactor, a descendant of the self-fueling concept. The research effort produced a design that not only minimizes the risks of plant operation and proliferation of weapons-grade fuel but that also maximizes the efficiency of power generation. In 2008, we created a spin-off to move forward with the technology. Today, TerraPower is exploring possible sites for a pilot plant.

Key to the success of this venture was the consortium of major investors who agreed to finance it. Intellectual Ventures secured their participation by offering incentives that matched their goals and interests. We balanced those interests with incentives reserved for sponsoring governments and participating companies. Before TerraPower, all atomic energy projects were essentially local: national or regional governments paid for them, then often spun them out into private industry. Intellectual Ventures pitched the traveling wave reactor as a global technology, one that had the potential to transform power generation and energy security worldwide with breakthroughs in the size and refueling configuration of nuclear reactors as well as new fueling options, in R&D including the ability to use the spent fuel from traditional reactors or even thorium.

The opportunity to take part in a long-term, transformational project in such a critical technology area appealed to a select group of wealthy individuals and long-term investors. These investors saw value in making a long-term commitment to ensure the vast, reliable amounts of carbon-free electricity that nuclear energy provides. Once the money was there, many scientists and engineers who had long believed in the technology leapt at the chance to carry it through to deployment. The commitments necessary to create TerraPower are a rarity in a field of research long accustomed to the ebb and flow of federal dollars, where good ideas were often left stranded by shortfalls in appropriations.

Intellectual Ventures worked hard to assemble and motivate the people required to make TerraPower happen. We did so by creating incentives for each that would move all toward a larger goal.

V. Innovation MegaProjects

Intellectual Ventures also has a program that helps governments build their own Innovation Ecosystems, based on incentives that motivate and reward all participants. Because of the incentive structure, these systems not only solve hard problems but also become self-sustaining engines of economic growth. Intellectual Ventures calls this approach an Innovation

MegaProject (IMP), and like our other programs, it fills a gap in the contemporary landscape of invention and innovation.

Like corporations, governments are no longer in the “innovation business.” They don’t have the expertise or connections to drive large innovation projects, and they can’t muster political consensus over the long time horizons needed to do so. Yet they must compete in a global economy driven by relentless innovation cycles and disruptive technology, while facing significant socio-economic and infrastructure problems at home.

An Innovation MegaProject builds an ecosystem of inventors, companies and financial partners that solve large-scale socio-economic problems while generating platforms for technological development that give the host government a competitive edge in the global economy.

Each IMP is organized around delivering a long-term, high-level solution, such as affordable, quality healthcare for the elderly; energy-efficient buildings with infinitely renewable infrastructures; efficient city transportation for people, products and waste; new commerce infrastructure to support small and micro-businesses; or safe and efficient agriculture and food supply.

Like classical infrastructure megaprojects such as roads, dams and subway systems, these projects will likely require billions of dollars in investment, but they will create innovation economies worth many times that because IMP ecosystems deliver more than solutions: they also stimulate ongoing economic activity and problem-solving.

They do so by creating sustainable incentives for each and every participant in the ecosystem. Inventors who sell their ideas, for example, get a good chance that their invention will be deployed, a small amount of cash up front and the lure of a long-term return. Various financial investors are looking for IRRs and yields over a certain period of time. Governments can point to tangible successes as the project achieves significant milestones every year. Small businesses get a government guarantee of demand for the products they innovate. And both government and businesses can exert their influence beyond domestic borders by participating in an ecosystem of product and services that could expand to the global market.

Once again, there’s something for everyone. Moreover, the structure of an IMP ensures that all participants stay motivated to interact, even after the original target problem has been solved and the new technology deployed. By establishing open platforms for innovation, it creates an environment of ongoing experimentation, investment and implementation. The ideas and solutions that emerge from this environment are likely to reach far beyond the stated goals of the project.

Because of the efficiency of the IMP ecosystem, government investment is far less than that for traditional government-sponsored projects, but the state, its domestic companies and its citizens reap far more. Such multiplier effects are what happens when an Innovation Ecosystem takes on a life of its own. The old three-player game may be over, but fortunately for all of us, it’s no longer the only game in town.