

Open Innovation @ HP Labs: Weaving Together Minds, Ideas and Resources

Martina Y. Trucco
Hewlett-Packard Co.
martina.trucco@hp.com

Lueny Morell, P.E.
Hewlett-Packard Co.
lueny.morell@hp.com

Richard J. Friedrich
Hewlett-Packard Co.
rich.friedrich@hp.com

Abstract

Technology -- by its nature -- is entrepreneurial. Innovation is the lifeblood of a technology company. One huge research breakthrough can have more impact on a company than many major acquisitions and cost-saving initiatives. A breakthrough can fundamentally change the nature of a company – what it can offer, how it can offer it, who it can offer it to. As the world’s largest technology company, HP recognizes that innovation is vital to the revenue and relevance of our company. As the central research group working on breakthroughs across HP’s businesses, HP Labs is at the core of that effort.

In March 2008, HP Labs announced a new blueprint for corporate research. We are balancing exploratory research with an entrepreneurial approach so breakthrough technology can be transferred more rapidly into commercial applications for customers. To do this effectively, we have focused our research around high-impact areas where our customers are facing their biggest challenges and that represent the biggest growth opportunities for HP. HP Labs created the Open Innovation Office with the goal of leveraging HP’s world-class innovation network to discover and nurture new opportunities to improve business and life. By assembling experts from around the world to advance thinking and foster discovery; leading collaboration on ground breaking programs; and identifying the next set of technology breakthroughs, we enhance HP Labs’ ability to pursue breakthrough research. Once a specific technical approach has been demonstrated successfully at HP Labs, our technology transfer office assists HP in deriving value from our work. In most cases, our innovations become products or solutions for HP, commercialized by existing businesses or instigating the creation of a new business. When this is not a fit for our technology, we pursue licensing or spinning out the intellectual property we have created.

This paper will describe HP Labs’ Open Innovation model and some of the programs, activities and outcomes of how we are weaving together minds, ideas and resources from around the globe to advance technology. We will also discuss the benefits, challenges and lessons learned from our open innovation model.

1. Introduction

Innovation is the lifeblood of a technology company. A single research breakthrough can have more financial impact on a company than major acquisitions or cost-saving initiatives. Examples at HP include ink-jet printers and RISC-based computers. As the world’s largest technology company, HP recognizes that innovation is key to the company’s vitality.

In today’s globalized world, however, ideas and innovation can appear both inside and outside of the company walls, and the path to commercialization today can take many different routes. In order for a company to successfully bring new products to market, it can no longer remain “closed” to the larger innovation ecosystem to which it belongs.

According to Henry Chesbrough, “Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. [This paradigm] assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology.”¹

In order to capitalize on the global wealth of knowledge and ideas, HP Labs works with partners in the international innovation network to advance our common technology vision. HP Labs’ Open Innovation goal is to

amplify our research investments through partnerships with industry, government and academia. Open Innovation projects underway include joint research with universities worldwide, research programs co-funded by governments, and collaborations with customers and partners. The HP Labs Innovation Research Program, now in its third year, offers the global university research community an opportunity to partner with HP Labs on cutting-edge research topics, while organizing HPL's academic collaborations into a strategic and visible portfolio. The showcase initiative Open Cirrus™ has brought multiple corporate and university partners together to advance a shared cloud-computing agenda. Finally, focused engagement with government agencies in the US, UK and selected strategic geographies helps broaden HPL's reach and ability to conduct critical IT research. In developing each program, HP Labs targets one or more of the key outcomes of Open Innovation: bringing together minds, ideas and resources.

Another dimension of Open Innovation is technology transfer. Corporate research operations create business value through technology transfer. Thus, by working closely with key partners in their business units, they commercialize innovations that result from research. Once a specific technical approach has been demonstrated successfully, there are a number of ways in which companies can derive value from their work. In most cases, innovations become products or solutions for the company, commercialized by existing businesses or instigating the creation of a new business. However, many companies also pursue licensing the intellectual property they have created, spin-out technology into start-up companies, or use their results as input to future research projects.

2. University Collaborations: HP Labs Innovation Research Program

Building upon HP Labs' history of successful collaborations with university researchers and students, in 2008 HP Labs established an open innovation approach to transition from a potpourri of informal collaborations into a unified, strategic portfolio of investments. Consequently, the Innovation Research Program (IRP) was launched in April 2008, providing opportunities for university researchers from around the world to engage in collaborative research with HP Labs scientists.

The IRP is a bold statement for the IT industry: it presents a detailed overview of our current areas of research, and invites others to invent the future along with us. It is designed as a global, open, competitive, annual call for proposals. HP Labs publishes a series of research topics, and interested researchers are invited to submit proposals for a collaborative project that aligns with one of the solicited topics. Awards range from \$50,000 - \$100,000 USD per year, and may be renewed for up to a three year project duration.

IRP calls have attracted over 700 proposals from more than 250 universities in nearly 40 countries in just two years, making for a highly selective program. In its inaugural year, Labs researchers reviewed more than 450 proposals from 200 universities in 28 countries, and selected 45 projects at 35 institutions in 14 countries to receive [HP Labs Innovation Research Awards](#)ⁱⁱ in 2008. [HP selected 60 professors](#)ⁱⁱⁱ at 47 institutions in 12 countries to receive HP Labs Innovation Awards in 2009. The selected project leaders reflect the truly global span of the program, including faculty at the University of California, Berkeley; the Indian Institute of Technology; Bombay, the Korea Advanced Institute of Science and Technology (KAIST); Carnegie Mellon University; and the Russian Academy of Sciences.

The results of these collaborations in just their first year are extremely compelling: 82 graduate student researchers have collaborated full- or part-time on projects, and HP Labs internal reviews rated average project performance at 4.28 (max = 5.00)^{iv}. Among the initial 45 projects, 61 papers were accepted for publication in their first year, and 13 HP invention disclosures were accepted^v.

Table 1. Publications by 2008 IRP awardees

	In preparation	Submitted	Accepted
Year 1	66	37	61
Year 2 (est)	92	88	78

(Note: Publication status as of March 2009)

Professors who are collaborating with HP Labs have also commented on the value the IRP has provided to them and to their students: “My students get the opportunity to work on problems with a practical application,” said Professor Kwan-Liu Ma of the University of California, Davis. “Furthermore, through our partners at HP Labs, we are able to obtain industry perspectives of each problem, leading to more comprehensive solutions.” The benefits are also tangible for HP: Professor Ma’s team is working with Kimberly Keeton, Senior Research Scientist in the Storage and Information Management Platforms Lab, on visually representing the complex relationships between documents and people, addressing the massive scale and overwhelming complexity of enterprise information. “Working with Professor Ma and his students has provided us with visualization expertise that we don’t currently have in our lab,” explains Keeton. “His world-class background isn’t just contributing to our research agenda, it’s helping us do things we wouldn’t have been able to do otherwise.”

The IRP includes attraction of external funding as a key part of proposal evaluation. 2008 projects averaged a 1:1 match of external funding to HP Labs’ investment, considerably increasing the impact of the program, and enhancing their ability to contribute to HP’s research agenda through support of additional students and other project resources.

In addition to supporting multi-year projects, the IRP program has also helped provide “seed” funding to attract external investments, as in the UK, for example. A 2008 IRP project, in the field of Enterprise Information Management, will continue with funding from the UK Office of Naval Research (ONR), providing future returns after one year of HPL funding. The Principal Investigator states that the initial IRP funding helped “prime the pump” for his work to successfully attract significant funding from the ONR.

2.1 Comparison with other industry programs

Many of the faculty researchers who have applied to the IRP are well-acquainted with other, similar industry funding programs. They have told us they view the IRP as unique in the industry: “Unlike other programs, the HP Labs effort does not seem focused on a specific HP technology,” stated a 2008 applicant. “Other [industry] programs have thinly disguised goals of improving market share of their specific products.”

Some companies have philanthropic programs but do not support university research. Others aim to support research at universities, but sidestep key issues in developing collaborative frameworks by providing “hands-off” donations or sponsorships, effectively hampering their own researchers from openly collaborating with their colleagues in academia.

At HP Labs, we believe university collaborations can have a significant impact on the state of the art, and eventually on our research contributions to HP. Open Innovation investments by HP Labs are therefore specifically designed not to be purely philanthropic: we invest because we believe there is potential for a relationship and collaboration that can lead to mutual benefit.

2.2 Single Collaborative Framework

Many of the historical challenges in engaging in productive partnerships between universities and industry have revolved around varying viewpoints on the role of intellectual property and legal frameworks for collaboration. Over the years, HP Labs has developed numerous successful research partnerships with universities, and we have found that the start of the working relationship can sometimes be delayed by a lengthy review of the legal framework for the collaboration.

Due to the size of the program we were creating in 2008, we realized that we needed a way to quickly execute a large number of awards and agreements on a yearly basis, and began to devise a strategy for a single collaborative framework. Developing a legal framework that all potential partners could agree on (on a world-wide basis, no less) was a daunting task. A critical success factor was to work closely with several university research administrators as trusted partners, in order to develop a framework that could be acceptable both to universities and to HP, allowing each party to pursue its fundamental mission.

Our approach is that both parties must have mutual freedom of operation: the university partner must have freedom to advance the creation and dissemination of knowledge, as well as to freely publish the results of the research; HP must also have freedom to conduct future research and to pursue its own strategies for commercialization.

A single-project Collaborative Research Agreement (CRA) for the IRP was developed and made [available online](#)^{vi} at the start of the call, providing university research administrators the opportunity to review it prior to

submission of proposals. In order to ensure that faculty do not submit proposals without their institution's review, proposals are required to include a signed letter from a university official that confirms that the university has reviewed the agreement. Only when the proposal is successful is the university required to sign the agreement with HP.

The reaction from our colleagues in academia has in general been positive: by engaging in an open and transparent process where all partners are equal, HP has managed to create the foundation for a systematic program that can truly support collaboration, and not simply "gifts" or donations.

While the HP Labs Innovation Research Program has been highlighted in this report as a flagship example of HPL's Open Innovation strategy in action, many other university programs take place at HP. For example, HP Labs has led or supported programs such as: HP Labs India's [HP Innovate](#)^{vii} 2008 and 2009 competitions, where undergraduate engineering students in India interested in technology entrepreneurship have the opportunity to present their innovative ideas in the field of computer science and engineering; the UNESCO-HP project to reduce "brain drain" in Africa through grid computing; and HP Labs Russia's highly-successful HP Institute of Technology program, which has established a Research and Education Center in St. Petersburg State University, providing opportunities for post-graduate students to collaborate with HPL Russia.

3. Commercial Collaborations: Open Cirrus™ Global Cloud Computing Testbed

Building on HPL's tradition of establishing major industry and academic consortia, as well as collaboration with HP customers and partners, HPL also puts a strong focus on developing strategic commercial collaborations.

In July 2008, HPL led efforts to develop [Open Cirrus](#)^{viii}™, a shared, open Cloud Computing Research Testbed, building on over eight years of research collaboration and co-funding with Intel (most recently through the Gelato Federation). As founding members of Open Cirrus, HP, Intel and Yahoo! are collaborating on an internet-scale, global testing environment designed to encourage research on the software, services, datacenter- management and hardware issues associated with cloud computing.

A collaborative initiative between industry, government and academic partners, Open Cirrus consists of nine "centers of excellence," to date, run by the three companies and their partners at Infocomm Development Authority of Singapore (IDA), University of Illinois at Urbana-Champaign, Karlsruhe Institute of Technology in Germany, the Russian Academy of Sciences, the Malaysian Institute for Microelectronic Systems (MIMOS), and the Electronics and Telecommunications Research Institute (ETRI) in South Korea. Each center hosts a cloud computing infrastructure with 1,000 to 4,000 processor cores.

Not only are HP's partners in Open Cirrus contributing significant computing and financial resources to the project, several government funding agencies have also contributed funds, including IDA in Singapore, the Ministry of the State of Baden-Württemberg (MWK) in support of KIT in Germany, and the US National Science Foundation (NSF) in support of UIUC. HPL continues to play a leading role in Open Cirrus' development, with the Central Management Office (CMO) housed at HPL, as well as hosting the first [Open Cirrus Summit](#)^{ix} in Palo Alto, CA in June 2009.

4. Government Collaborations: ASEE-NSF Industry Research Fellows Program

In March 2009, HP Labs - with the support of several other corporate research labs - approached the US National Science Foundation (NSF) with the idea of establishing an Industrial Research Innovation Post-Doc Fellowship Program. This program would allow top science and engineering post docs to work on industrial research and development and partner with industrial scientists in developing the next generation of engineering and IT-related technologies, increase opportunities for tech transfer into new businesses opportunities, advance their careers and finally, enhance the possibility of creating innovations in the engineering/science curriculum. The initiative was seen as particularly relevant to the contemporaneous economic situation, enhancing participants' likelihood of obtaining a job and/or creating new jobs through new business creation while the US and global economies recovered. The program would also provide opportunities for future engineering professors to acquire real-life engineering experience and impact the engineering/science curriculum.

4.1 The Pilot - Corporate Research Postdoctoral Fellowship Program

The idea presented in March to the Engineering Directorate (Engineering Education and Research Centers Division) was very well received. In May 2009, NSF asked the American Society for Engineering Education (ASEE) to submit a proposal to support a number of engineering post docs in corporate research labs for one year.

Since 1893, ASEE has provided intellectual leadership and accomplished professional support for educational activities that advance the United States' science and engineering enterprise. This history of both dynamic collaborations with other science and engineering organizations and innovative, society-based programs, has established ASEE as an integral contributor to collective efforts to build the nation's human capital in science and engineering. With its 48+ years of experience administering student and faculty fellowship programs, over 20 years of experience managing postdoctoral fellowship programs, and its industrial relationships, ASEE was uniquely positioned to manage such a program.

Thus, in early September 2009, NSF granted ASEE funds to establish the Corporate Research Postdoctoral Fellowship Program to encourage the involvement of creative and highly-trained engineers in areas of great interest and relevance to the nation as we face current economic challenges. This program provides recent engineering PhD recipients the opportunity to conduct post-doctoral research in a corporate setting. Up to 40 positions are anticipated in 2010. Each research fellow will receive a stipend of at least \$75,000 plus health insurance benefits, of which the host company would provide a minimum of \$27,500 and other non-cash support.^x

4.2 Benefits to Participants and the Economy

In a time when the global economy is facing enormous challenges, creating jobs must be a top priority. Some of these jobs should also produce significant technological and scientific innovation that will allow the economies to recover and begin to create new opportunities for business growth and prosperity. This program's goal would support government efforts to create an atmosphere in which employees may prosper, businesses may thrive and the economy grows.

Participants in this program will enjoy both near-term and long-term benefits: in the near-term, they will obtain an immediate position at a prestigious industrial research lab, providing them with a stable job and income, as well as critical career development opportunities as they continue to develop their research capacity. In the long-term, participants may be offered full-time positions in participating companies and their research labs, or may find that their networking and experiences have prepared them to join the faculty at a research university or another company in their area of expertise. Participants in this program who choose an academic career could bring new curriculum perspectives and approaches to engineering/science education as well as expand the research horizons by bringing new hard problem areas.

Some participants may embrace opportunities to transfer technology inventions into start-up businesses, and may start their own companies. In sum, these positions will provide key economic stability to participants while preparing them to further develop their careers and contribute to the economy in years to come.

4.3 Benefits to Corporate Labs

Many corporate research laboratories, such as HP Labs, are proud to offer opportunities to a large pool of qualified post-doctoral candidates through this proposed program. It is clear that this program will offer a significant benefit to companies, providing the chance to advance critical scientific, engineering and IT research at a faster pace, during a time when hiring full-time researchers is a challenge. Faster research outcomes are likely lead to increased opportunities to transfer technology to businesses and/or spin-out companies and more opportunities for growth. This program would also allow corporate labs to identify top technical talent who may be recruited for full-time positions after their industrial research fellowship position is finished.

4.4 Other Government Collaborations

In addition to co-leading development of the ASEE-NSF program described above, HPL also partners with governments around the world to jointly support Open Innovation programs. In the UK, for example, HP Labs

teams with the UK Engineering and Physical Sciences Research Council (EPSRC) to support graduate and post-graduate studentships at the HP Labs Bristol site.

HPL also partners with HP Brazil to incorporate university scientists in Brazil into their projects as part of an annual set of investments funded by HP Brazil through government tax incentives for external research, building on many years of successful partnering with HPL. In 2009, 27 projects were underway at 11 leading Brazilian universities; focus areas of the work include Cloud Computing, IT Analytics, Nanoelectronics and Cybersecurity, among others.

5. Lessons Learned and Recommendations

As the HP Labs Innovation Research Program heads into its third year in 2010, and we further develop our Open Innovation programs, several key lessons have emerged:

Shared Risk. A partnership where both parties share risk means both parties are invested in the collaboration and its ultimate results. Additionally, relationships are of critical importance in building trust and a collaborative environment.

Look for Complementary Expertise and Experience. Work with partners who can enhance your own research capabilities, instead of looking to universities to “outsource” R&D.

Start Small. When building a new relationship, start small and prove successes early and often so that stakeholders can clearly see the value of the partnership and will thus be more supportive of growing the collaboration over time.

Set clear goals. Make sure that everyone involved with a project knows what is expected of them, including student researchers. This leads to a more predictable, productive, and positive collaboration.

Technical papers, not PowerPoint. Industry researchers are measured on many of the same outcomes as academics. Successful partnerships stem from concrete outcomes that are recognized as valuable by both parties.

Flexibility. Recognize that while partners may have similar research aims, their goals and approach may be different. Reasonable collaborative and IP terms allow both parties to pursue their fundamental mission. Similarly, partners should also evaluate each situation individually: research in IT differs greatly from, say, research in biotechnology, and each case has its own requirements and characteristics.

Listen to your stakeholders. Ultimately, any open innovation program should be in service to its stakeholders; when designing a new program, ensure that all participants have what they need to be successful, and positive results will follow.^{xi}

Martina Y. Trucco and **Lueny Morell** are members of the Strategy and Innovation Office at HP Labs. **Richard J. Friedrich** is Director of the Strategy and Innovation Office at HP Labs.

ⁱ Henry Chesbrough, *Open Innovation: Researching a New Paradigm*. Oxford University Press, 2006.

ⁱⁱ HP Labs Innovation Research Program 2008 Awardees:
http://www.hpl.hp.com/open_innovation/irp/2008_results.html

ⁱⁱⁱ HP Labs Innovation Research Program 2009
Awardees:http://www.hpl.hp.com/open_innovation/irp/2009_results.html

^{iv} Source: Internal HP analysis

^v HP Labs: “*Pushing scientific frontiers by partnering with the best*” 15 June 2009.
http://www.hpl.hp.com/news/2009/apr-jun/IRP_awards.html

^{vi} HP Labs Innovation Program home page: http://www.hpl.hp.com/open_innovation/irp/index.html

^{vii} HP Innovate Program Handbook:
http://h50025.www5.hp.com/ENP5/Admin/UserFileAdmin/EV/25572/File/handbook_low.pdf

^{viii} Open Cirrus web page: <https://opencirrus.org/>

^{ix} Open Cirrus June 2009 Summit: <http://www.hpl.hp.com/news/2009/apr-jun/OpenCirrus.html>

^x Morell, Lueny, Martina Trucco, Richard J. Friedrich. “Developing the Next Generation of Technology Leaders in Challenging Times: the ASEE-NSF Industry Research Fellows Program.” submitted for presentation at the 2010 ASEE National Conference, Louisville, Kentucky, June 2010.

^{xi} Trucco, Martina Y., & Richard J. Friedrich. The HP Labs Innovation Research Program: Re-inventing Industry-University Research Collaboration. *NCURA Magazine*, *XLI* (3), pp. 22-23. (2009, July/August)