CHAPTER 17

Hi-Tech Industry and Universities: A Perspective on Dating for Joint Innovation

Michel Bénard [1]

INTRODUCTION

As recorded since the very beginning of our written history, knowledge has been progressing by accumulating the experience of past and present generations (Van Doren, 1991). The creation of new knowledge has been performed by various actors: priests, hunters, philosophers, farmers, artists, craftsmen, soldiers, faculties, business people, scientists, managers, etc. Relationships between these various knowledge creators have occurred either formally (in schools, or corporations, or public forums) or informally (in all possible venues, including individual visits, migrations and dramatic events). One can say that innovation has been able to happen in almost all possible circumstances, including and even better under adversity.

More recently, a critical mass of knowledge has been created and accumulated in academia, public research institutions and industry. With the world becoming more global and innovation more important for the development of countries, there has been a growing need for these different institutions to

1 This paper was written with the collaboration and help of several colleagues of the HP Open Innovation Office team whom I would like to thank: Vinnie Jauhari (based in India), Martina Trucco (based in Puerto Rico), Lueny Morell (based in Puerto Rico), Sheri Brodeur (based in Boston, U.S.), Igor Belousov (based in Russia), Xiang-yi Yao (based in China), Shinya Nakagawa (based in Japan), Jason Tan (based in Singapore), Arnaud Pierson (based in Switzerland) and Rich Friedrich (based in Palo Alto, U.S.). Also I would like to give special thanks to Luc Weber for reviewing this paper.

collaborate more and better (Weber, 2006). For sure such collaborations had already happened many times in the past, but recent economic trends have created a specific increased need for academia, public research institutes and industry to perform joint innovation.

This paper is about the special relationship between academia, public research institutes and industry when it comes to jointly innovate. In section 2 the paper first explores the new motivation for the Hi-Tech industry to increase its external relationships to better innovate. Then in section 3 the planning, dating and execution for joint innovation are described in detail. Section 4 then addresses the new global context in which such joint innovations are performed. Examples are taken from the corporate experience of the author and his colleagues of the Open Innovation Office at HP Laboratories. The conclusion looks at some future trends for joint innovation.

HI-TECH INDUSTRY RESEARCH AND INNOVATION

R&D Spending Trends

In September 2005, Technology Review published the Corporate R&D Scorecard (Fig 1.a). R&D spending of 150 Hi-Tech companies was analysed in terms of absolute spending in US$, R&D as a percentage of sales, and R&D per employee. First significant differences in average R&D investment could be seen between sectors: about 23% of sales for biotechnology, 7% for computer hardware, 14% for computer software, 2% for consumer products, 16% for semi-conductors and 4% for transportation. Also within a given sector like computer hardware, one could notice different levels of R&D spending ranging from 4% to 17% of sales. Different business models could explain such differences within the same sector. Some companies would mainly compete on the technology innovation level (like Sun or EMC), while other companies would rather compete on the business model and spend less on R&D (like Dell). Such differences in R&D spending were also noticeable in other sectors like computer software and telecommunications. This study shows that the needs for acquiring external knowledge and R&D from universities are not similar between companies, even within a different sector.

Need for Innovation

Companies spend most of their R&D budget doing D (Development) rather than R (Research). The development time for a new product is closely linked to the life-cycle of the product. Some products, such as printers, have a life-cycle of a couple of years and their development time can be as short as three months. Other products, such as computing servers or software releases, have a much longer life-cycle (up to a few years) and their development time can scale up to several years. Usually time-to-market is a key parameter for the success of the product and little or no time can be spent to accommodate external partners with a different agenda and timetable to develop product components. In addition cost constraints are intense in Hi-Tech product development and constant tradeoffs have to be made by the development team between functionality, time-to-develop and cost. In some cases, razor-thin margins in the lower one-digit numbers gave cost constraints a lead in the absence of breakthrough innovation, such as for personal computers before 2005. In other cases the innovation factor was so overwhelming that cost constraints became secondary, such as for the iPod ®. In this complex environment, most external product development partnerships are usually between industrial companies used to operate within similar constraints, and rarely with universities. For developers in a Hi-Tech company, universities can perform targeted tasks unrelated with critical product development, such as tests in specific scientific environment, or sanity checks about some new technological assumptions, or search for alternative technologies. The university faculties and students can provide interesting and provocative, out-of-the-box concepts which can be of great interest for development teams when planning next product releases or checking the market acceptance of new products. One interesting case can be read about the Illinois Institute of Technology and HP in digital photography in the late 90s (Frascara, 2002, pp. 208-218.)

Relationships with Universities — Dating for Joint R&D

While the most attractive target for industry-university partnerships is product development, it is also the most difficult to succeed into. A common fallacy is to believe that a university will act like an industrial partner when dealing with product development, and this unfortunately leads to severe misunderstandings, to unmet commitments and deliverables, and ultimately to a deterioration of the relationship between the two partners.

Some companies have kept within their R&D budget a significant component for R (Research). Usually the R component is a one-digit percentage of the total R&D budget. However for large companies like HP, IBM or Intel, this R budget is still significant in terms of absolute dollars. Research Labs in private industries are special entities where research is conducted in selected areas of interest with the expectation to develop future products within 5-10 years, sometimes even later. In this respect, industry research Labs share some similar goals with universities and public research entities, and have a natural need and interest to collaborate with them (see Fig. 1b). This collaboration can start with public domain presentations and publications at conferences and journals, and expand into joint research projects and participation to public research programs, such as those organized by the National Science Foundation in the U.S. or the Framework Programs in the E.U.

However this initially attractive-looking match has to be balanced with several constraints and the organization of partnerships between private industry labs and universities or public research entities has to take these constraints into account. The first constraint is still related to life-cycle considerations. Usually the turnover of named strategic research topics in private research labs is faster than those within public institutions or those of public research programs. This can lead to discrepancies in terms of the actual length of the planned joint collaboration and its desired outcomes. It also potentially limits the company lab in its ability to change research directions according to new business interests. The second constraint to handle is still related to cost. Large research investments from private companies are usually not rewarded by Wall Street, and are seen more as a cost than an investment, or even than an asset. This tendency has taken more importance in recent years with the pressure on companies to reward their stockholders sooner rather than later and therefore to cut all perceived unnecessary costs accordingly. As a consequence, the current size of most research projects undertaken by private companies is relatively limited and has a hard time to be scaled up in the absence of external funding. Government-sponsored public research organizations have well understood these two constraints and provide more attractive frameworks and conditions for private companies to undertake research in collaboration with local universities or public research labs. This happens especially in many emerging economies; however more mature geographies have been ramping up their attractiveness for company research programs as well.

The environment for joint research projects between private company labs and universities and public research institutes is therefore more favourable than the environment for joint product development projects, even if the size of the projects is smaller. For the private company lab, the deliverables of such projects can in some cases be expressed in research results otherwise hard or impossible to get alone, along with important direct or indirect talent recruitment.

Open Innovation Model

Recent frameworks such as Open Innovation in opposition to traditional Closed Innovation (Fig 1.c) have been developed in the literature to explain the growing importance of external research partnerships and their attractiveness for all parties involved.

The Open Innovation Model (Chesbrough, 2003) calls for partnerships between a company R&D entity and researchers from the following institutions:

- Universities.
- Public Research Laboratories.

- Government Research Programs (such as NSF, EU FP, MEXT, etc.).
- Non-for-Profit organizations.
- Other companies.

The initial assumption is that for a given research theme expertise and talent are not concentrated only inside the company, but rather disseminated among the institutions mentioned above. The next step is to find these external talents and to collaborate with them in order to join forces and obtain potentially better research results. The gain in time, resources and effort often offsets the exposure taken by collaborating openly with external organizations.

At HP we have been implementing Open Innovation since several years and have practised several different instances:

- A global Call for Proposals to Universities (http://www.hpl.hp.com/open_innovation/irp/).
- Collaborations with companies in global joint projects (www.open-cirrus.org).
- Several participations to DARPA, EU FP7 and other government programs.
- Organization of Open Source Federations (www.gelato.org, www.dspace.org).
- Joint Programs with UNESCO and Joint Research and Education Programs in specific countries (http://portal.unesco.org/fr/ev.php-URL_ID=27009&URL_DO=DO_TOPIC&URL_SECTION=201.html).

PLANNING, DATING FOR AND EXECUTING EXTERNAL R&D WITH UNIVERSITIES

Planning

Setting up an Agenda

The first task to be performed in the planning of External R&D is the establishment of a comprehensive agenda. As mentioned in the previous section, corporate R&D can be conducted to discover new technologies for future products, or to produce new business models, or to perform a combination of both. Usually the list of R&D topics that have to be investigated by the company R&D organization is a long list, addressing multiple problems. It is frequently the case that the resources available are outnumbered by the needs expressed in the list. In addition the company R&D organization sometimes does not have all the right skills and people to address a particular problem,

Figure 1a: Corporate R&D Scorecard

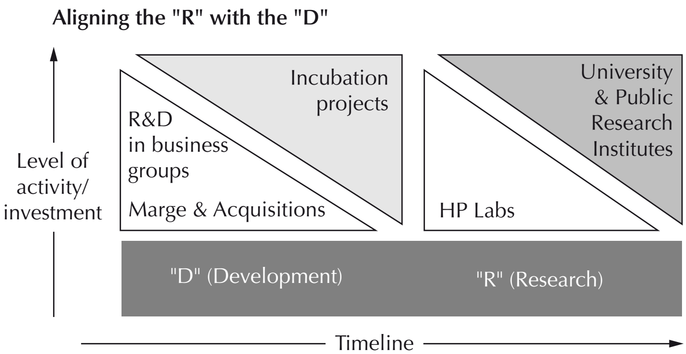
*BASED ON DATA FOR MOST RECENT FISCAL YEAR, ENDING MAY 31, 2005. SOURCES: STANDARD AND POOR'S; COMPANY WEBSITES; *TECHNOLOGY REVIEW*

56 FEATURE STORY TECHNOLOGY REVIEW SEPTEMBER 2005

Company name (country)	Rank by Innovation Index	R&D spending 2004* (in millions)	R&D percent change	Absolute change over 2003 (in millions)	R&D as a percentage of sales	R&D per employee	Research focus
Computer hardware							
IBM (U.S.)	23	$5,167	2%	$99	5%	$15,705	Deep computing, displays, e-commerce, semiconductors, storage
SUN MICROSYSTEMS (U.S.)	38	$1,926	5%	$89	17%	$59,080	Business PDA applications, device networks, speech technology, Java
TOSHIBA (Japan)	55	$3,149	2%	$49	6%	$19,523	Film, optics, wireless communication, transistors
HEWLETT-PACKARD (U.S.)	59	$3,506	-4%	-$146	4%	$23,219	Internet systems, wireless communication, security, privacy, printing
EMC (U.S.)	72	$848	18%	$129	10%	$37,352	Storage
FUJITSU (Japan)	90	$2,346	-12%	-$326	5%	$15,025	Internet services, ubiquitous computing, computational science, security
NEC (Japan)	91	$2,400	-13%	-$370	5%	$16,739	Banking systems, e-government systems, optical, IP and device networks
SEIKO EPSON (Japan)	114	$633	-2%	-$13	6%	$9,808	Printers, projection, electronic components, optics
Average	**68**	**$2,522**	**-1%**	**-$61**	**7%**	**$24,556**	
Computer software							
MICROSOFT (U.S.)	2	$7,779	67%	$3,120	21%	$136,474	Multimedia, search, knowledge management, security, machine learning
ELECTRONIC ARTS (U.S.)	41	$633	24%	$122	20%	$103,398	Enterprise software, extensible systems, open-source software
SAP (Germany)	62	$1,298	3%	$33	14%	$40,290	Business process applications, e-business
AUTOMATIC DATA PROCESSING (U.S.)	96	$581	16%	$82	7%	$13,837	Data processing and outsourced services
ORACLE (U.S.)	118	$1,278	8%	$98	1%	$30,678	Grid computing, Web services, Java, Linux, open-source software
COMPUTER ASSOCIATES (U.S.)	122	$690	4%	$28	20%	$45,098	Mobile gaming, motion capture, 3-D face and body rendering
Average	**74**	**$2,043**	**20%**	**$581**	**14%**	**$61,629**	

Source: Data from Technology Review 2005 http://www.technologyreview.com/articlefiles/2005_rd_scorecard.pdf

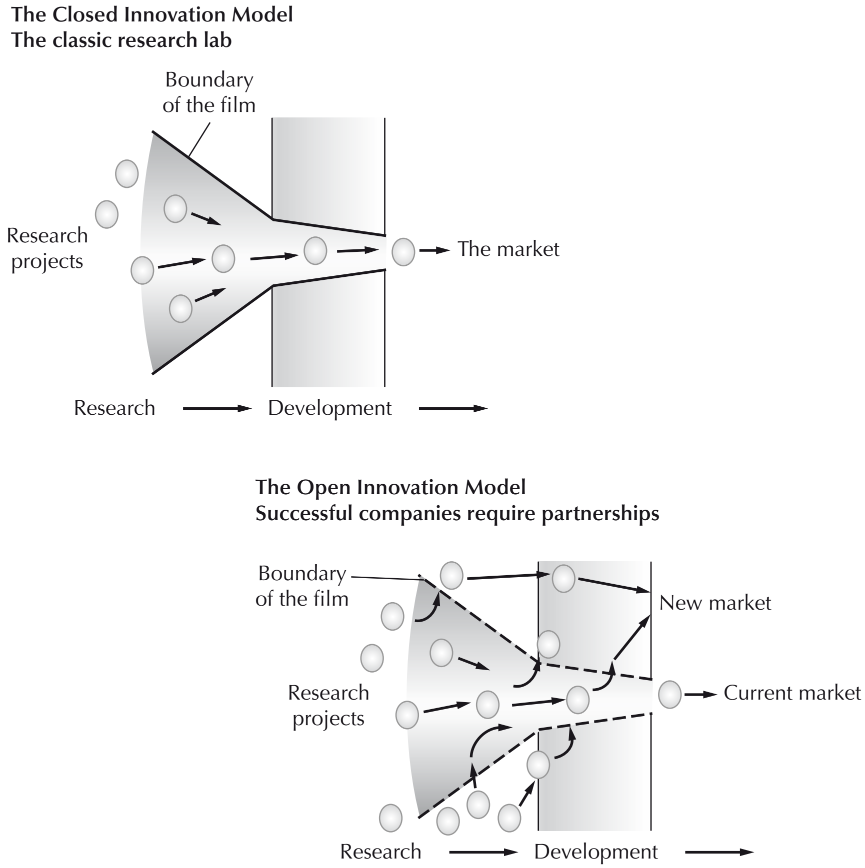
Figure 1b: Timeline of university research, company research and product development (from HP)



and building such capacities takes a long time. Finally some problems are perceived as temporary and requiring a short-term effort rather than a long-term organizational involvement.

All these reasons call for an in-depth look at the opportunity to outsource R&D, especially to universities or public research organizations. This is a

Figure 1c: Closed Innovation vs. Open Innovation models



make vs. buy decision, which has to be prepared carefully. In particular, the following points have to be clarified before selecting a particular topic in the list for external R&D candidate topics:

- Is this topic considered strategic? Does the company want to own the knowledge about it?
- Is the research affordable? How long would it take to get results? At which cost?
- Where is the expertise located for this topic? Who would be best positioned to help?

Answering these key questions is a pre-requisite before entering into the investigation for potential external R&D partners. Once these questions are answered for each topic targeted for external R&D, an agenda can be constructed. Sometimes this agenda can be shown as a "technology map" where the different R&D topics and their main components are shown and their source (internal or external) is mentioned. Such a map (as shown in Fig 2) can help to make trade-off decisions between topics and refine the external R&D strategy.

Figure 2: Example of technology map used for building an external R&D agenda

	Topic 1	Topic 2	Topic 3	Topic 4
Relevance for the company R&D	Not strategic	Strategic	Not strategic	Public Domain
R&D effort estimated	1 Man/Year	2 Men/Year	3 Men/Year	10 Men/Year
Potential external R&D partners	Universities A, B, C and D	Competitor X University C	Company Y	NSF or EU project
Proposed decision	Outsource using Call for Proposal	Do internally	Negotiate partnership	Participate to the project
Cost	Low	High	Low/Medium	Low
Time to market	Not critical	Critical	Medium	Not critical

Dating, selecting potential partners and thinking out-of-the-box

Once the external R&D agenda is built, the next step is to identify among the potential external partners those likely to provide the R&D as required. This is a match-making process which can be run in very different ways with potential external partners:

- Individual meetings and conversations at exhibitions or conferences.
- Call for Proposals sent to universities globally or in a given geography.
- Regular relationships with particular campuses or research institutes.
- Web 1.0 and 2.0 interactions with targeted external researchers and faculties.

Each of these dating approaches has its own pros and cons, and the authors have been practising most of them at different stages for different purposes. Conferences and exhibitions are grouping specialists of a given topic in a location to make presentations, publish papers or posters and exchange ideas during coffee breaks and dinners. Such events are very powerful for identifying potential external R&D partners and exploring their interest and availability to build a R&D partnership.

A broader or next approach is to publish a Call for Proposal on a given set of topics to universities. Universities are asked for project proposals with a submission deadline. Once the proposals are received, they are reviewed and a few of them are selected. This approach has the advantage of identifying new unknown partners and offering potential positive surprises to the company R&D organization. An example is the Call for Proposal performed by HP Labs in 2008 and 2009 (http://www.hpl.hp.com/open_innovation/irp/).

The practice of a regular and strategic relationship with selected research partners (companies, universities and public research institutes) provides a rich networking environment where ideas can be explored and R&D partnership established when there is a match in areas of interest. This approach however requires dedicated local company representatives to cover selected major campuses, public research institutes and private partners.

Finally today websites provide a rich database of papers, public research results repositories and descriptions of research activities which can be consulted for identifying and calling potential external partners. It is also possible to scale-up this investigation with Web 2.0 technologies (blogs, forums, twikis etc.) which provide a more dynamic exchange and sometimes even instant results for the investigation (Tapscott, 2007).

One important opportunity which is frequently overlooked or not taken into account is the investigation of external R&D partnerships outside the traditional research areas of the company R&D organization. Sometimes problems identified by a company R&D organization were already solved, at least partially, by another organization. For example, in HP Labs one very efficient data centre energy optimization technology was recently bought from the aerospace industry, where air flow optimization has been one key expertise since the very beginning of plane construction. In identifying and assessing potential external R&D partnerships it is therefore important to keep an open approach to allow out-of-the-box opportunities, or "black swans", to be investigated and considered (Taleb, 2007).

To summarize, the investigation and selection of potential external research partners are one of the most intriguing and interesting steps of the planning of external R&D. This is also a challenging task since it provokes make-or-buy considerations and out-of-the-box thinking.

Competitive Analysis

The world of R&D partnerships is a busy world where competition is intense to team with the best and brightest in a given technology topic. When considering a potential R&D partnership, several questions have to be addressed about the potential partner:

- How qualified is the potential partner? What is his/her research reputation?
- Is the potential partner available? Or already booked? What would the turnover cost?

- What is the price of the collaboration? What would the terms and conditions be?
- What is the overall relationship between the company and the potential partner?

The question of the qualification and research reputation of the potential partner is an important one. Beyond the expected quality of the research, there are also time to market and marketing considerations to consider carefully. Partnering with recognized world experts on a given subject derives fame or even hype, but also exposure and a strong expectation to succeed.

Even the best research partner can fail to deliver if his/her agenda is already full. Project turnover is a key parameter to investigate when considering a new R&D collaboration.

The price of the collaboration depends on geographic, political and economic factors. Besides the price of external researchers and their infrastructure, overhead costs have to be considered as well. One sticky point can be the price of the intellectual property (IP) generated by the project and the ease of doing business with the Technology Transfer Organization of the partner.

Finally a very important factor to watch carefully is the overall relationship between the company and the potential partner, including the commercial relationship when applicable. R&D partnerships can be plagued by poor commercial relationships or unsustainable competitive pressure.

All these points are trade-offs at the source of intense debates within R&D organizations. It is interesting to watch how different companies answer some of these questions by either teaming with big dollars with only a couple of top campuses, or by spreading their money thinner with multiple but less famous partners.

Execution

Investment Strategies

When there are many topics retained for potential external R&D and significant investments to be decided, a portfolio analysis may be needed. The goal of the portfolio analysis is to position the different potential external R&D activities in a risk/reward diagram, and to look at the overall risk that the company is planning to take. Senior management can then decide which risk strategy is acceptable and guide the overall investment accordingly. The investment strategy consists in the following steps:

- Evaluation of expected return and risks.
- Evaluation and choice of a portfolio strategy.

Return: The total planned external research investment includes cash, personnel and expense costs. This total amount has to be compared to the investment which would be needed internally to execute the same research. Thus a conservative expectation for the return of external R&D should be the equivalent return if the project were done internally. Having considered this, one might want to consider more aggressive investments, i.e. focused investments expected to return much more than the standard investment described above. This may happen in the following scenarios:

- Leverage of a significant external funding opportunity (in specific emerging economies etc.), or seeding of a relationship that develops into a collaborative partnership with significant external funding (in E.U. with FP7, in the U.S. with NSF, etc.).
- Focus on a campus powerhouse expected to deliver much higher returns.
- Focus on a transformation topic in an out-of-the-box approach.

Risk: The risk on any individual investment includes a factual risk and a perceived risk. The factual risk includes the dollar amount of the investment plus the internal people cost which will be involved in the external project. The perceived risk derives from the importance the company R&D organization assigns to the hype of a subject, the reputation of a campus, the history of a relationship and the ultimate belief that everything will be fine or not. This latter risk can play in two directions: increased confidence or increased defiance.

The goal of the company R&D organization will therefore be to maximize the expected Return while minimizing the Risk (especially the perceived risk) of the portfolio of investments.

A *Conservative Portfolio* allocates the investment in a uniform way, and may or may not allow a couple of more focused aggressive investments. It can then be difficult to raise the expected average return beyond the return of the same projects internally. The risk can be perceived as low. Companies that are new in the business of external R&D partnerships usually adopt a conservative portfolio by teaming with well-recognized faculties from top campuses. In a similar way that an IT manager in the 80s would not be fired by choosing IBM (a common stand at that time), an External Research manager is unlikely to be blamed for choosing to work with a few top faculties from major campuses in the company areas of interest.

A *Balanced Portfolio* makes a few bigger bets in focused areas, decrement more conservative projects accordingly, but still invest in those that are most promising. Compared to the conservative portfolio, the balanced portfolio can raise the expected average return by a factor of two or three. The factual risk certainly increases as well. The balanced portfolio encourages the company R&D organization to increase reasonably its risk tolerance with academic projects. Companies like pharmaceuticals usually cultivate a balanced portfolio with a set of major campus partnerships and a few major investments.

An Aggressive Portfolio increases significantly the number of focused investments and leads to factual and much higher perceived risks. However the potential return can scale up to about five times the expected one with a conservative portfolio. Some Hi-Tech companies cultivate an aggressive portfolio approach, by placing significant investments behind a few well-targeted directions.

Negotiation

Once the investment strategy has been chosen and the potential partners defined, negotiations can start with the potential partners. This is a combination of science and art. Science is based on partnership contract templates, different IP terms and other contractual parameters that the company can prepare as negotiable or non-negotiable items. The practice of the negotiation itself shows that even if this contractual science was prepared carefully, Art often applies in getting a win-win outcome. The literature and experience relate some successes, but also some significant failures. In any case, the length and the cost of negotiation should usually not be higher than the length and the cost of the joint project.

However in today's world IP is often perceived by all parties (industry, university, government) as a key strategic asset around which the whole partnership negotiation has to be articulated. This assumption is popular because IP can be measured with some well recognized parameters: number of patents, licensing revenues and other trade statistics. The assumption that IP should rule the negotiation is better suited for some industries than other, the difference being often time to market. For example, in the IT industry it is frequent to see hot new technologies becoming common or even public domain after a couple of years (Raymond, 1999). Therefore the window of opportunity can be very short for major IP revenue goals. The situation is of course completely opposite in other industries, such as the pharmaceutical industry. For this reason in many cases IP negotiations should be taken with an open mind and with the desire to find mutually reasonable terms, rather than to maximize IP revenues.

Partnership negotiations also have to take into account other factors, such as the other on-going relationships between the company and the university. These relationships can include a vendor-customer relationship, transfer of people between the two parties (visits, sabbaticals or even hiring) and other contacts (VIP visits, joint participation to events, joint PR and communications). Therefore a positive and friendly business relationship climate has to be maintained during the negotiation, regardless of the financial goals of some of the negotiators. Major account management techniques have to be practised to ensure that no dispute will disrupt the company-university relationship, or affect other company business in the geography.

Finally the practice of negotiations in different geographies requires the accommodation of different cultures and practices. This can be cultivated at the company headquarters level in close partnership with local employees and company partners. In the global world of R&D partnerships, local policies, economic conditions and business practices do play a major role.

Project Management

Once the joint R&D project is signed, and after the reception and cocktails, the joint R&D work can start. Traditional project management techniques (Bauer, 1992) can of course apply to ensure that the project will deliver the desired results. However a few very specific and important considerations have to be taken into account.

The project will be co-run by two teams with complete different cultures. R&D corporate culture is very different from academic culture. Initial meetings should concentrate on building mutual understanding and trust before rushing to the deliverables. It is a good practice to organize in the beginning of the project frequent visits, discovery meetings and social events to build the joint team. What will be spent for this purpose will be saved manifold for the project in the future.

A university will unlikely develop a commercial product. The joint R&D team has to rather concentrate on goals like exploring new concepts, doing sanity checks and building proofs of concept or prototypes. The company R&D team should rather leverage the fresh innovative approach of university faculties rather than try to force them to apply product development techniques.

R&D engineers and project managers are measured by their management by comparing the results of their projects to clear articulated project goals. Academics are evaluated by their peers according to the review and success of their publications. Therefore it will be important to accommodate these two different sets of values in the evaluation of the joint project results. Initially this looks like mixing fire with water, but in practice it can turn out to be easier. For example the peer review of academic publications is a very thorough process requiring the faculty to submit well documented research results with proofs and examples. Such results and their presentation can often be of great interest for the industry partner.

The ability to accommodate different geographies in the joint research project portfolio can be a tremendous opportunity and competitive advantage for a company external R&D agenda. However it requires a careful understanding of the local education system, policies and working practices. This applies in the practice of the joint R&D project as well. Having two teams from two continents collaborating requires special care and techniques to make communications successful and projects completed.

Measuring Success

The measurement of success in external partnerships or open innovation is a science and an art. The science includes multiple well- or not-so-well-engineered operational parameters which can be measured along the lifetime of the external partnership: number of publications, financials, number of people, etc. The art includes serendipity, intuition and luck.

For sure the marital life between both science and art is a delicate experience, which requires a lot of openness and patience from the stakeholders. Here are a few of the tradeoffs.

Process vs. Content

Process and content are closely linked to each other, and the success of external partnerships requires a good balance between both. A pure process-driven approach may miss lifetime opportunities and the ultimate power of intuition. A pure content-driven approach may often lead to the exhilarating cultivation of joint dreams with the external partners, with little or no likelihood for any tangible result.

Human Capital vs. Finance

Financial measurements such as Return on Investment, External Funding and Licensing Business Forecasts are important to put the project in perspective, especially for large multi-year collaborations. However Human Capital is also in the essence of success in R&D, beside investment. Access to talent has to be a key objective of open innovation.

Publications and Technology Transfers

As mentioned before, the reward systems of academia and industry are completely different. The success of the partnerships will therefore have to be measured using publications (rewarding for academia) and technology transfers (rewarding for industries). Some campuses however, such as Stanford University, have cultivated a very strong track record of managing a pipeline of successful start-ups out of the innovation projects.

THE GLOBAL CHALLENGE

In today's flat world (Friedman, 2006) the competition between universities is intense on a global basis to perform the best research and the best curriculum. Between governments there is also an intense competition to develop the most attractive education and research economic strategy (Vietor, 2007). Many countries, at the national or regional level, offer comprehensive programs to attract external R&D investments from the private sector. Government matching funds, or tax returns, or other facilities (real estate opportunities in technology parks, student programs, etc.) are offered to attract corporate R&D investment. This plays a very important role in the selection of external R&D partners.

While financial and logistical conditions can make or break a deal, it is important to keep a cold focus on the initial external R&D objective. The trade-off is then to find the right balance between R&D and business (sometimes even company trade balance) objectives. For companies which are growing on a global scale, initial beachheads can be made in new geographies using external R&D partnerships within an attractive local economic environment favourable to such new ventures. On the other hand, geographies which make it difficult to establish R&D collaborations or do not provide any economic incentives can plague the development of company external R&D despite the availability of local talent. Recent experience has shown that easy-to-do-business-with IP policies are also played by several geographies as a competitive factor in order to attract companies R&D investments.

The 'undisputable' Attraction of Emerging Geographies

The numbers are all pointing in the same direction: emerging geographies (Brazil, China, India, Korea, Middle-East, Russia, Singapore, etc.) are dramatically scaling up their innovation capabilities in technology and science. This starts with the number of students in the higher education system, the ranking of universities and ultimately the number of graduates (Fig. 3).

Figure 3: Global Trends in Higher Education: New Engineers in 2008 in the World

The world produces about one million engineers every year:

USA & Canada	≈100,000
China	≈400,000
India	≈300,000
Europe	≈100,000
Australia	≈8,000
Korea & Japan	≈150,000
L & S America	≈200,000
Middle-East and Africa	≈50,000

Source: Data from Professors Seeram Ramakrishna (National University Singapore) and Venky Narayanamurti (Harvard) IFEES conference in Paris, May 2008.

In addition to the ramp-up of their talent pool, emerging geographies have been cultivating since several years a set of other competitive advantages:

- Cost, skill and motivation of workforce.
- Ease-to-do-business with attractive public policies.
- Motivation to grow, perform and develop national capabilities.

The combination of these factors is today building a true economic comparative advantage to emerging geographies universities when it comes to attract, perform and deliver external R&D for global or local companies. One of the important facts confirming this trend is the reverse brain drain from mature economies of the western world towards emerging geographies: talented faculties and knowledge workers are leaving mature economies to join new innovation structures in emerging geographies. This applies not only to people who were born in these emerging geographies and went to the mature countries to study or get initial work experience, but also to mature geographies-born citizens who are attracted by new opportunities in emerging geographies.

This gives emerging geographies a clear undisputable attraction to companies to perform innovation related work.

The 'still-matters' Attraction of Traditional Geographies

The fascinating TED video shows a novel new human-machine interface for cell phones/computers developed by MIT: (http://www.ted.com/talks/pattie_maes_demos_the_sixth_sense.html). The content of this video speaks by itself: the cocktail of talent, motivation and insight is impressive and shows the power of campuses like MIT when it comes to innovation. Companies are still investing a large fraction of their external R&D dollars to get access to such breakthrough innovation in the major campuses of mature geographies (U.S., Europe, Canada, etc.).

In addition several major campuses have developed over the years a unique and powerful strategy to incubate start-ups and make them successful. For example, the track record of Stanford University is impressive: HP, Sun, Cisco, Yahoo, Google and many other hi-tech companies started from the Stanford campus. Also the venture capital ecosystem is an impressive innovation and growth engine for several geographic locations in mature geographies: Silicon Valley, Oxbridge, Munich, etc. Finally, large public research programs (NSF, DARPA, EU FP7, MEXT Japan, etc.) are also very welcome for companies looking for public domain research with academic and industrial partners.

This makes mature geographies still matter to companies to succeed in innovation related work (Kaufman Foundation Report, 2009).

Some examples

Here are some examples from the HP Laboratories vintage:

HP Russian Institute of Technology (HP RIT):

A joint curriculum between a company and several major universities in Russia.

In February 2009 HP and the community of 12 leading Russian universities announced first results of HP Russian Institute of Technology (HP RIT) program's work. Since it was launched in January 2008, the following results have been achieved:

- HP RIT Community has grown to 12 distinguished universities from all over Russia, such as Moscow State University, St. Petersburg State University, Moscow University of Printing Arts and many others. HP RIT research and education centres have been established or are planned to be established in all universities of the community.
- 22 education courses and 8 laboratory works have been developed and already made available to students at the universities of the RIT community. New courses and lab works are to be launched and shared within the community in the nearest future.
- More than 40 university professors are involved in the program and over 1,500 students have already studied at RIT centres.

The main goal of RIT program is to provide students and university professors with access to the information on the latest technologies. HP provides latest hardware, software and financial support for creation of RIT research and education centres at participating universities. For example, a special Digital Printing Center based on Indigo 5500 has been created at Moscow State University of Printing Arts.

HP experts and professors at universities then work together to develop educational courses and bring IT training programs to the new levels in order to turn their students into highly qualified IT professionals with knowledge of most recent technologies. New courses and laboratory works that cover "Parallel Programming", "Network Technologies" and many others have already been successfully added to the curricula of Moscow State University of Printing Arts, Bonch-Bruevich Saint-Petersburg State University of Telecommunications, Moscow Institute of Physics and Technology, Stavropol State University and Samara State Aerospace University. Additional courses, such as "Nanotechnology", "Bio-informatics", "Virtualization" and several others are currently being developed and will soon be available to all students at universities taking part in the program. Later on the courses will be translated into English so that European universities could add them to their training programs as well. It is also in the plans to make all courses available to the majority of Russian universities upon request.

HP and MIT Alliance:

HP and MIT have had a very long relationship that was formalized into The HP-MIT Alliance in June of 2000, by Carly Fiorina and Chuck Vest, the then President of MIT. This was a $25M/5yr program in "Digital Information Systems" with the goal of launching larger, multi-year programs that would hopefully have more of an impact than a collection of smaller projects.

Under this Alliance five new major programs were launched, one was a consortium with other companies (Oxygen), but the other four were HP-MIT programs, and all yielded good results for both HP and MIT.

The four HP-MIT projects launched under the Alliance were DSpace, an open source digital archiving system, an Imaging research program in printed electronics, a Quantum Information program and the Wireless Networking Center.

HP Innovate Program in India:

This initiative was started by HP Labs Open Innovation Office in India to create a platform to showcase the potential of young engineering undergraduates in India. The program was initiated in the year 2007 and the first round was concluded in the year 2008. Technical submissions and prototypes were invited from more than 200 engineering colleges in the first phase. The themes under which the submissions were invited range from cryptography, embedded technology, image processing, nanotechnology, virtualization, data mining and so on. There were about 17 technology themes which were included for the first round of submissions.

Outcomes of the first round: There were 382 students which participated across 124 teams from 51 institutions. These teams participated from all regions across India and had a maximum of four members per team. Each team had a faculty mentor as well.

The submissions for HP Innovate were all double blind reviewed and had more than 35 reviewers who assessed the submissions. Based on initial assessment, the top ten themes were invited to present their work. The top three teams won HP hardware such as tablet PCs and iPAQs. The winning team was taken to Palo Alto for interaction with HP Labs researchers. The Indo-US Science and Technology Forum in India supported the visit of the HP Innovate winning team's trip to the U.S.

The winning teams were also provided an opportunity to showcase their work in the "Labs to Market" session of *Em*Tech, a prestigious event of Technology Review which was hosted in 2009. The teams had an opportunity to share their work with venture capitalists and other technology firms and institutions.

CONCLUSION: FROM SPEED-DATING TO LASTING RELATIONSHIPS

Is innovation manageable? This candid question is asked in (Haour, 2004). At the conclusion of this paper it would seem that the answer should be positive rather than negative. A massive and impressive global innovation system is at work today to train the technology professionals, to launch and cultivate ambitious public research programs, and to build more relationships between industry and academia. The recent history of technology progress has shown that managed innovation can score and is likely to score impressive successes. On the other hand it will remain important to keep enough flexibility in the system to encourage and benefit from more chaotic innovation, such as those that happened in the past.

This paper has described several aspects of the organized innovation when it comes to the collaboration between hi tech industry and academia, including in the context of public research programs. Methods and processes are today available and well practised to make this dating process happen. Certainly, this does not always predict the outcome and success of the relationship, and whether this relationship will be closer to speed-dating than to a more lasting one. But at least the steps described may help to organize the intention of the industry-academia relationship and create a positive environment for it.

An interesting next step could be to explore how joint innovation could be further used to work on today's grand challenges and problems. This approach has been pioneered by a few universities which have established specific dedicated centres, such as CITRIS at UC Berkeley (http://www.citris-uc.org/). It might be also interesting to explore how such approaches would facilitate the analysis of future technology trends in a similar way that this has been done for business (Schwarz, 1991).

REFERENCES

Books:

Bauer R., Collar, E. & Tang, V. (1992). *The Silverlake Project*. Oxford University Press.

Berkun, S. (2007). *The Myths of Innovation*. Sebastopol, CA: O'Reilly.

Chesbrough, H. (2003). *Open Innovation*. Harvard Business School Press.

Frascara, Jorge (Ed.) (2002). *Design and the Social Sciences: Making Connections*. London/New York: Taylor & Francis.

Friedman, T. (2006). *The World is Flat*. New York: Farrar, Strauss and Giroux.

Haour, G. (2004). *Resolving the Innovation Paradox*. New York: Palgrave Macmillan

Kaufman Foundation Report. (2009). America's Loss is the World's Gain, America's New Immigrant Entrepreneurs (Part IV). Authors: Vivek Wadhwa, AnnaLee Saxenian, Richard Freeman, Gary Gereffi & Alex Salkever.

Raymond, E. (1999). *The Cathedral & the Bazaar*. Sebastopol, CA: O'Reilly.

Robinson, A. & Stern, S. (1997). *Corporate Creativity*. San Francisco: Berrett-Koehler Publishers Inc.

Schwartz, P. (1991). *The Art of the Long View*. Doubleday (USA).

Taleb, N. N. (2007). *The Black Swan*. Penguin Group (USA).

Tapscott, D. & Williams, A. (2006). *Wikinomics, Portfolio*. Penguin Group (USA).

Van Doren, C. (1991). *A History of Knowledge*. Ballantines Books (USA).

Vietor, R. (2007). *How Countries Compete*. Harvard Business School Press.
Weber, L. E. & Duderstadt, J. J. (2006). *Universities and Business: Partnering for the Knowledge Society*. London, Paris, Geneva: Economica
Weber, L. E. & Duderstadt, J. J. (2008). *The Globalization of Higher Education*. London, Paris, Geneva: Economica.

Websites:

MIT demo: http://www.ted.com/talks/pattie_maes_demos_the_sixth_sense.html
Dspace Federation: www.dspace.org
CITRIS http://www.citris-uc.org/