SCIENCE|BUSINESS INNOVATION BOARD

*The leadership forum to help Europe innovate*

# MAKING INDUSTRY-UNIVERSITY PARTNERSHIPS WORK

## *Lessons from successful collaborations*

**This report was commissioned by the Science|Business Innovation Board AISBL. The Board is a Belgian not-for-profit scientific association that performs original policy research, engages with policymakers and the press, and works generally to improve the climate for innovation in Europe. Its members include Science|Business, ESADE Business School, INSEAD, Microsoft, BP, SKF, Foley & Lardner LLP, Aalto University and Imperial College London. Further information, including other innovation-policy research, is at www.sciencebusiness.net**.


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# ABSTRACT

**Universities and industry have been collaborating for over a century, but the rise of a global knowledge economy has intensified the need for strategic partnerships that go beyond the traditional funding of discrete research projects. World-class research universities are at the forefront of pioneering such partnerships. They are designed to run longer, invest more, look farther ahead and hone the competitiveness of companies, universities and regions. In short, they transform the role of the research university for the 21st century, anchoring it as a vital centre of competence to help tackle social challenges and drive economic growth.**

But it's a big leap. It requires each side to engage far beyond the conventional exchange of research for funding. When they work well, strategic partnerships merge the discovery-driven culture of the university with the innovation-driven environment of the company. But to make the chemistry work, each side must overcome the cultural and communications divide that tends to impair industry-university partnerships of all types and undercut their potential.

This report aims to address the challenge of bridging the industry-university divide by highlighting what makes universities attractive as industry partners, what structures make for excellent partnerships and what approach produces seamless interactions. It builds on a growing pool of academic research about the state of industry-university collaboration and offers concrete lessons and recommendations from experienced managers on both sides of the divide.

The empirical lessons in this research lead to some obvious policy conclusions. They include:

**1. Keep the ship steady.** Policymakers need to ensure a predictable, stable environment of funding and regulation for long-term strategic partnerships to thrive.

**2. Give universities the autonomy to operate effectively, and form partnerships.** The best people to decide a university's strategy are its own board and faculty heads, not government ministries. Without freedom to operate – with appropriate checks and balances – they cannot form effective partnerships.

**3. Reward activist, collaborative universities – and encourage more to be that way.** Funding incentives work: government policy should reward, or at least not discourage, universities and companies that form strong partnerships. New government programmes, such as proposed by the EU and some national governments, should entice others to take the same step.

**4. Help universities strive for excellence.** Companies want to work with the best – and so Europe must take care always to feed and promote its best universities, in order that more job-creating partnerships can be formed.

The report was commissioned by the Science|Business Innovation Board AISBL, a not-for-profit scientific association create to improve the climate for innovation and Europe. The case studies of innovative and successful partnerships featured were recommended by members of the Board, among other experts. The authors would like to thank the Board members, company executives and academics for their contributions to this report.

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# OVERVIEW

## KEY LESSONS

**When companies and universities work in tandem to push the frontiers of knowledge, they become a powerful engine for innovation and economic growth. Silicon Valley is a dramatic example. For over five decades, a dense web of rich and long-running collaborations in the region have given rise to new technologies at a breakneck pace, and transformed industries while modernising the role of the university.**

For an elite group of world-class research universities, this kind of strategic collaboration is top priority. The benefits have long been obvious to these institutions: substantial streams of external funding, enhanced opportunities for professors and graduates to work on groundbreaking research, vital inputs to keep teaching and learning on the cutting edge of a discipline, and the impact of delivering solutions for pressing global challenges.

If only it were so easy. For most universities – even those with cutting-edge research – partnering with industry does not come naturally. Most European academics are not engaged at all in collaborations with industry and only few cooperate with business to a high degree, according to a May 2010 study of Ewuropean university-business cooperation.[1] And when European universities form partnerships with industry, too often the potential for synergy is thwarted by failures of communication.[2]

What makes for a seamless relationship between university and industry? Why do so many partnerships produce disappointing results or fail? And how have some visionary companies and their academic partners successfully overcome their inherent differences to forge a higher level of strategic partnership? These are the key questions addressed in this report. Its findings are based on the views and experience of senior industry executives and university officials engaged in managing successful partnerships.

The most productive collaborations are strategic and long-term, according to the practitioners who contributed to this report. They are built around a shared research vision and may continue for a decade or beyond, establishing deep professional ties, trust and shared benefits that work to bridge the sharp cultural divide between academia and industry. “It is individuals who understand both worlds – academia and business – that are the driving force behind successful partnerships,” says Alan Begg, Senior Vice President, Group Technology Development, SKF Group.

Strategic partnerships designed to run for five to ten years deliver greater and often unanticipated benefits to all parties through a virtuous circle of interactions. For the

university, they provide a longer stream of secure funding that can bolster academic strength. They help modernise teaching and learning by fostering an exchange of ideas and developing people with the skills and competences needed as new innovations transform markets and industries.

Above all, long-term alliances build the vital human capital needed to make the industry-university collaborations work. It is the human ties, understanding and trust on both sides of the partnership that count most. Over time, a well-managed partnership produces a growing number of professors and graduate students who can think and act across the cultural divide, connect with the key research interests of a company and work harmoniously to define big and common strategic goals. That substrate of human talent not only ensures the success of existing projects; it is key to developing future collaborations.

One example: IBM's new $90 million nanotechnology center in Zurich illustrates that virtuous circle. The Binnig and Rohrer Nanotechnology Center is the cornerstone of a new 10-year strategic partnership in nanoscience between IBM and the Swiss Federal Institute of Technology (ETH Zurich) aimed at advancing energy and information technologies. Ties between the two parties run deep; the investment caps many years of collaboration.

Creating more strategic industry-university partnerships such as this would substantially improve Europe's climate for innovation. The agenda for the modernisation of Europe's higher-education systems has made it a priority to strengthen the links between higher education, research and business to drive innovation. The future EU programmes on education (Erasmus for All) and research and innovation (Horizon 2020) will ensure that such interactions are fostered and fully exploited.

The Commission already has launched a number of initiatives to enhance closer and more effective ties between the three corners of the knowledge triangle, including the European Institute for Innovation and Technology (EIT), the Knowledge Alliances pilot project and the University-Business Forum.

But the cultural divide between universities and industry runs deep. It continues to act as a brake on effective collaboration with the business world, according to an October 2011 study on European University Business Cooperation undertaken by Technopolis.[3] The experts who contributed to this study believe the cultural divide can be overcome, but it requires strong university leadership, faculty who understand business, and incentives and structures for academics to bridge that gap. European universities could significantly increase their attractiveness to industry, these experts said, by making industry partnerships a clear priority and by developing a pool of academics who have worked in industry.

This report was commissioned by the Science|Business Innovation Board AISBL, a not-for-profit scientific association formed to improve the climate for innovation in Europe. The Board strongly concurs with the European Commission's university modernisation agenda and the need to make universities more responsive to demand in the marketplace and active participants in their innovation markets.[4]

The aim of this report is to complement – and add more of a business perspective to – a growing body of academic studies on the state of European industry-university partnerships. It was designed to be selective in nature, with a focus on the insights and lessons learned from a handful of groundbreaking partnerships. Each case study was based on lengthy interviews with senior executives and university managers who oversee these partnerships. Several cases focus on US university partnership initiatives, reflecting the fact that American educational institutions have spearheaded the evolution of large-scale industry-university collaborations. But Europe also has many prominent, and productive, strategic partnerships.

The cases included in this report vary widely in their aims, and each had a variety of impacts on the university partner. They have been grouped here under three key categories based on particular points of interest to policymakers:
partnerships that increased funding streams for universities
partnerships that had a significant impact on teaching and learning, and
partnerships that prompted a rethinking of the role of the research university.

This report draws on the direct experience of the Board's members– on both sides of the 'market': the universities supplying talent and ideas, and the companies demanding them. It also benefits from the input of practitioners from companies and universities identified by Board members and others regarded as pioneering a new era of industry-university partnerships, including Siemens, Nokia, ETH Zurich, Karolinska Institutet, the University of California, Audi, IBM, GE, and Aalto University. Interviews were conducted from 6 January through 3 February 2012.

The Science|Business Innovation Board is grateful to all the interviewees for their contribution to this report. It is our hope that this breadth of perspective will prove useful.

## KEY LESSONS FOR PARTNERSHIPS

The industry-university partnerships analysed for this report varied widely, but the executives and academics managing them agreed on the core elements needed to make a partnership work well. Their key lessons and recommendations were the following:

***1. University leadership is vital***

- University presidents need to make industry-university partnerships a strategic priority and communicate the message regularly to the entire academic community.
- Strategic partnerships need input at the highest level from both the company and the university. Create a joint steering group including senior academics and company executives.
- Make the goals and benefits of partnering clear to the entire faculty.
- Design incentives for university faculty and provide resources to manage a cultural shift that does not undercut basic research but puts a clear priority on engaging with industry for mutual benefit and for the benefit of society.

***2. Long-term strategic partnerships with built-in flexibility work best***

- The most fertile starting point for a partnership is one that allows industry to do something it can't do itself, executives said. The world's leading technology multinationals have dozens, if not hundreds, of strategic partnerships with universities. But increasingly, the trend is to narrow the focus on a handful of strategic partnerships that aim higher, receive significantly greater funding and last longer. These partnerships increasingly will drive richer benefits to fewer universities.
- The growth of these alliances reflects the evolution of corporate R&D away from basic research toward research that is much nearer to the company's immediate needs. As a result, a gap has emerged in industry's ability to peer into the future, and industry is increasingly turning to universities to know what is going on at the frontiers of research.
- Long-term strategic partnerships focus the university's creativity and talent on enabling future innovations that can be taken to market by industry and deliver benefits to society within five to 10 years.

***3. Start with a shared vision and develop a strategy***

- The first step to a healthy partnership is assessing the core academic strengths of the university and the core research competence of the company to identify promising opportunities for collaboration.
- Senior executives and university experts should map out together the key questions and research challenges that are a high priority for both. Encourage sufficient high-level exchange of information and brainstorming to enable common areas of interest to emerge.
- Understand the three different types of possible partnerships – strategic, operational or transactional – and select the type that fits your needs.
    - Strategic partnerships run for five to 10 years and need a broad, flexible agreement. The knowledge produced by the collaboration is likely to influence the university's future research and teaching and a company's strategy.
    - Operational partners have a research project with a division or particular R&D lab and run for one to three years. They can be valuable for building ties that lead to a strategic partnership.
    - Transactional partnerships are lesser interactions, such as an executive agreeing to teach a course, which may lead to doing more and bigger projects together in the future. These, too, can ultimately give rise to a strategic partnership.
- Strive for a partnership of equals with shared decision-making. Successful partnerships are based on a win-win situation for all the parties.

***4. Put the right people in charge – those who cross boundaries***

People determine the success or failure

of industry-university partnerships. To attract industry involvement, universities must have people capable of building and managing partnerships. Collaborations only work well when they are managed by people who cross boundaries easily and who have a deep understanding of the two cultures they need to bridge.

University programmes need to be strongly orientated toward helping solve the scientific and technological challenges that companies care about. That means breaking down barriers inside the university and engaging faculty who have industry experience.

Universities must become more open to giving people leading positions who bring more than just a research pedigree. They need multidisciplinary individuals who are mentors and bridge-builders. Most universities engaged in partnerships are "learning by doing," and lack academics with experience in industry or the proclivity to network outside their area of expertise.

***5. Kick-start the dialogue – encourage cross-fertilisation of ideas***

There is no short cut to cultivating personal ties that can lead to the most creative and promising collaborations. Universities should create opportunities for academics and company researchers and executives with shared interest to come together and develop a dialogue. Informal exchanges over lectures or seminars that bring both sides together can spark conversations and lead to new relationships.

To understand the key scientific and technology questions companies are seeking to answer, universities should create advisory boards of executives from selected industry sectors where they are well positioned to develop partnerships.

Once a potential industry partner is in view, universities should engage with top management. Academics need a relationship with someone who is senior enough at the company to allow strategic issues to emerge and to be addressed in research.

When a partnership has been launched, an executive board should be formed and meet regularly to encourage strong two-way communications between academics and senior company officials. The chair should follow up regularly with members to keep the dialogue flowing and encourage impromptu feedback on the project from both sides at any time.

Develop two-way exchanges to build a substrate of academics who understand industry. Universities should encourage professors to work in industry and invite industry researchers to teach.

***6. Don't get hung up on intellectual property (IP)***

Develop a broad overarching framework agreement and work out details on a case-by-case basis. A framework agreement saves time and avoids the acrimony that often results from too narrow a focus on who owns what. Company executives tend to walk away from universities that have too inflexible an approach to IP, no matter how good the science.

IP is important but it should not be viewed as the centrepiece of industry-university relations. Instead of a narrow focus on IP as income source, universities should be engaged in providing solutions for the economy – the income stream will be greater and benefits wider.

The role of IP is overemphasised. The true value in R&D is often the tacit knowledge it produces.

Universities seeking to form partnerships with industry to modernise teaching and learning should not insist on protecting IP that comes out of that research. The key benefit to the university is the impact on teaching and learning from industry-based projects.

### *7. Promote a multidisciplinary approach to research and learning*

Innovation increasingly depends on the ability of university and industry experts to work together across a number of disciplines, such as technology, design and engineering. Encourage multidisciplinary academic programmes and promote the engagement of industry in such programmes.

Setting up a multidisciplinary institute on campus in partnership with industry can help break down traditional academic silos and drive a new multidisciplinary culture and curricula.

University officials seeking to develop partnerships with industry risk losing projects if they are not willing to embrace a multidisciplinary approach to research.

### *8. Don't get hung up on measuring the results of a strategic alliance*

The most fruitful partnerships take time to bear fruit. Setting up artificial metrics to measure them can undercut the alliance and fail to capture the unanticipated benefits that accrue when a strategic relationship is built on trust, structured well and managed by people who understand both worlds.

Projects should have defined objectives, for example, finding a class of materials that have certain properties. But companies and universities should avoid trying to measure the value of an industry-university partnership in metrics such as papers published or patent applications filed. The quality and nature of scientific breakthroughs vary, and volume does not automatically equate with value.

Focus on quality instead of quantity of output. Select projects from the outset with a focus on excellent science through peer review of projects and funding. This builds in quality control up front, attracts industry investment and ensures better results.

### *9. Redefine the role of the research university as a source of competence and problem-solving for society*

Bold, visionary partnerships between industry and universities can accelerate innovation and help deliver solutions to pressing social challenges. But to harness that tandem, the mission of the research university needs to be redefined. Collaborating with industry should be linked to a redefinition of the role of the research

university for the 21st century. That role now extends beyond teaching and public service research to tackling key social challenges and helping drive economic growth.

Today's universities largely embrace a model of higher education developed over 100 years ago. A new vision should include producing the highly skilled workforce for a globally competitive economy.

The university in the 21st century should be viewed not just as a generator of ideas but as a source of knowledge and competence that can benefit society.

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*3 Ibid.*

*4 Science|Business Innovation Board. "Time for university reform – with market principles." 30 August 2011.*

II

# PARTNERSHIPS THAT IMPACT TEACHING AND LEARNING

**The primary focus of most industry-university collaborations is joint research, but many have an impact on teaching and learning that develops naturally out of the partnership. Professors join a project inside the company and researchers agree to lecture, creating a fruitful ongoing exchange that helps modernise curricula.**

But a growing skills gap and fierce competition for global talent have prompted some forward-looking companies to develop partnerships with universities specifically aimed at modernising teaching and learning. The partnership itself becomes a groundbreaking experiment in developing new skills for a next-generation workforce and a conduit for future recruitment of top talent. Two such partnerships are included here (ICT21S and Aalto's IDBM programme).

Another groundbreaking approach involves partnerships that establish a multidisciplinary research institute in which industry researchers and academics pursue solutions to complex, systems-level problems that require cross-disciplinary expertise. The creation of high-profile multidisciplinary institutes can help break down traditional academic silos by creating incentives for new areas of research, seeding new courses of study and multidisciplinary degree programmes, while also driving innovation (e.g. BP's Energy Biosciences Institute at the University of California and Calit2). These and other cases highlight the increasing role industry can play to modernise curricula, improve the knowledge base and skills of future graduates and foster economic competitiveness.

**CASE 1**

## MICROSOFT-CISCO-INTEL-UNIVERSITY OF MELBOURNE:

A partnership to forge skills for the 21st century

*Key interview: Greg Butler, Senior Director Worldwide Education Strategy, Microsoft; and Visiting Research Associate, School of Business Management, Open University, UK*

In 2008 Microsoft, Cisco and Intel agreed to launch an industry-university partnership with the University of Melbourne that set out to transform education for the 21st century. Their goal was to have a game-changing impact by first identifying the higher-order skills that students need for success in schools and in the workforce and then transforming the assessment and teaching of these 21st-century skills. The partnership, called ATC21S – Assessment and Teaching of 21st Century Skills – focuses on the critical skill sets for a global knowledge economy.

Microsoft, Cisco and Intel have all had long-running individual programmes to boost skills in the classroom, but none felt as if they were having enough impact. "Young people were not being equipped with the skills needed to be successful in employment. You only have to look at unemployment and mismatch of skills and jobs," says Greg Butler, Senior Director Worldwide Education Strategy at Microsoft.

Moreover education has been slow to respond and to take up the challenge of the assessment and teaching of new 21st century skills. "The partnership of corporations and university set out to lead the way to new forms of assessment that would drive new approaches to teaching and curriculum. A radical shift in the three pillars of education was needed," says Patrick Griffin, the project's executive director.

To tackle the task, the core partners formed an executive board to manage a three-year multi-stakeholder effort, involving some 250 academics and multilateral institutions including the OECD and UNESCO. The partnership identified two discrete skill sets: collaborative problem-solving and digital literacy. And the three-year research effort produced knowledge, tool sets and common standards that transfer across borders.

## KEY INNOVATION

This multi-stakeholder industry-university partnership overcame general skepticism that collaborative problem-solving skills and digital literacy could be accurately measured. It managed a highly complex global academic research effort across 60 research institutions to successfully develop a new set of tools (computer-based collaboration and problem-solving) to assess skills that will form the basis of new curricula. Cost of project $2.5-$3 million (additional resources were contributed by the many academic and multilateral organization partners).

The assessment tools present complex, multi-step, cognitively challenging problems to be solved in real time by pairs of students who communicate via computers to arrive at a solution. The computer-based program then assesses how each of these students collaborate.

"This remarkable initiative… has cracked the code on how to set standards for, and assess the acquisition of, 21st-century skills," says Robin Horn, education sector manager for the World Bank, adding that "measuring skills such as critical thinking, problem-solving, collaboration and teamwork, ICT competencies, and information literacy, in a rigorous and pragmatic way, has been totally out of reach until now…. It is a harbinger of a wholly new approach to standards and assessment for the 21st century."

Andreas Schleicher, special adviser on education policy to the OECD and founder of the PISA (Programme for International Student Assessment) study says: "ATC21S has played an essential pathfinder role to move the assessment agenda forward. It fills a critical gap between existing basic research on assessment design and methodologies, on the one hand, and the implementation of large-scale assessments that provide reliable data at reasonable cost, on the other. Its latest venture, the

piloting of tasks to assess collaborative problem-solving skills, provides important insights for OECD's efforts to broaden future PISA assessments to encompass interpersonal skill dimensions."

## RESULTS

Five white papers defining the skills of the 21st century, peer-reviewed and published in leading journals

- Assessment tools created for two core skill sets: collaborative problem-solving and ICT literacy.
- Six countries (Australia, Costa Rica, Finland, the Netherlands, Singapore, and the United States) piloted the assessment skills in cognitive labs on 5000 students. Fieldwork trials are continuing.
- Results presented at the 2012 Education World Forum in London
- Singapore developing strategy to deploy the assessment tools broadly

The OECD PISA study will incorporate assessment of 21st century skills in 2015

- Curricula recommendations to support an improved workforce will be published in June 2012.

## LESSONS

***1. Partnerships have a high cost in human capital***. Do them as a last resort – when you can't accomplish the goal alone. "If Microsoft had chosen to do this work alone, it would have had minimal impact. There was tremendous value in the partnership," says Microsoft's Butler.

***2. Build partnerships on a set of principles. The golden rule is understanding each other. Spend time on the agenda of each party***. "If you ignore the other party's agenda, the partnership won't work," says Butler. "I had to understand the agenda of the academics at the University of Melbourne. We call it brokering. Too often, it's 'let's partner' and six months later it all blows up because no one asked, 'What are your objectives?' "

***3. Ensure equity in the partnership***. "Rarely does everyone have equal power around the table," says Butler. "The attitude of industry could be, 'We are funding, so you do what we tell you.' You need to negate that power imbalance. If we pulled the power play it wouldn't work. The academics won't trust us. It would be contractual. If we wanted to do a contract that's easy. You'd say, 'I've got money and work and can you do it?' But you lose the diversity and innovation that the partnership brings. If [an equal] partnership drives the innovation, you get more innovative solutions and better solutions. "You can't be half-hearted in the partnership – we are all in control and everyone is responsible. The executive director came from the University of Melbourne, so in one way we report to the university. We have meetings where everyone has an equal say. We spent time to make sure everyone's objectives are clear. A partnership has to deliver mutual benefits. A guiding principle to partnering should be the following: 'Is everyone getting mutual benefit out of this work. If so, you get better results.' "

***4. In some cases where the goals are broad and social in nature, success may depend on dropping claims to intellectual property.***

**"**All the output from ATC21S is in the

public domain. This was critical in building a partnership with researchers and governments," says Butler. "If we had said, 'You do the work and we will copyright it,' I am sure we would not have been successful.

"Most of the cross-boundary transactions we do at Microsoft are done by contract. The same is true with universities. The purpose of a contract is to shift risk. Most of risk ends up lying with a person who receives the contract – it says you are liable if you don't adhere to the contract. But with complex problems we have today – in education, environment, global warming – we will never solve those problems if we continue to only try to shift risk. We have to build mechanisms to share accountability. Because problems by nature cross boundaries. You can't write a contract to solve environment problems today."

***5. Partnerships need to be flexible:*** The ATC21S partners aimed at concluding their work within three years – in June 2012, but they are now considering extending the work plan to engage with ministry officials in governments around the world on how to deploy the results. "We think this partnership might evolve into a number of masterclasses for government leaders, helping them build policy and implementation plans," says Butler. "We never thought about that at beginning. We realised only recently the risk if we published the results of the work and ministries didn't take it on board. Partnerships can't be rigid. You need flexibility and the ability to evolve."

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*Statement on ATC21S by Robin Horn,*

*World Bank:*
*http://blogs.worldbank.org/education/how-can-school-compete-with-social-media*

**CASE 2**

## AALTO UNIVERSITY FORMS PARTNERSHIPS WITH INDUSTRY TO TRANSFORM TEACHING AND LEARNING

*Key interview: Mikko Koria, professor of international design business management, Aalto University*

In 1995 the then rector of the University of Art and Design Helsinki, Yrjö Sotamaa, proposed a graduate programme blending design, technology and business courses across three universities to create a new field of multidisciplinary study. The goal was to develop students with an innovative mindset through collaborative, cross-disciplinary problem-solving.

The programme, International Design Business Management (IDBM), was set up as a full-year minor study offered jointly by the Helsinki School of Economics, the University of Art and Design, as well as the Helsinki University of Technology, to complement majors in engineering, design or business – or other subjects. The programme is balanced equitably between business, engineering and design learning.

The IDBM challenged the notion that a university's role is to pass on existing

knowledge, and that absolute answers exist. “The real world doesn’t work like that. Sometimes, you don’t even know the question, says IDBM professor Mikko Koria. “Our answer was to work with industry. We want to bring the real, confusing world into the teaching of the master’s programmes. You cannot simulate something like that because it is not open-ended enough. You cannot simulate the messiness of the real world. You have to involve real companies.”

IDBM is now part of the offering at Aalto University, which was formed by the merger of the same three universities in 2010 to promote multidisciplinary learning – another initiative proposed by Sotamaa. Now in its 17th year, the IDBM has become a strong platform for ongoing collaboration with Finnish industry that offers competitive advantage to companies while creating a real-world learning experience for students. Multidisciplinary teams tackle industry problems and produce innovative solutions over the course of a one-year programme. In return, each company agrees to pay the school roughly €20,000 per project.

The IDBM projects involve teams of multicultural and multidisciplinary students who drive their own learning experience. Companies offer students real-world, open-ended problems to solve that the company cannot address itself. The teams seek to offer new perspectives and ideas that cross-fertilise with what the company already knows, says Koria.

Work projects range widely from fathoming new applications for mobile radar or waste-water technologies to assessing the innovative potential of Vietnamese companies. In one project, the Helsinki airport asked a team to figure out how to tailor the design of the airport’s new terminal and services to appeal to its Asian passengers. The team included a Japanese interior architectural student, a Chinese business student, a Finnish architectural student and a British business student. The students travelled together to all the major Asian airports to research cutting-edge design and services that cater to Asian passengers. Out of some 30 proposals made by the team, Helsinki airport implemented over 20 in the new terminal.

## INNOVATION

At the time of its introduction in 1995, the IDBM’s engagement with industry in using cross-disciplinary teams was a groundbreaking approach to transforming teaching and learning. Through project-based learning that takes place inside companies, it developed the missing skills and experience vital for workers in a networked, global economy while strengthening ties substantially between the universities and industry.

“Society’s problems do not exist in silos. Pollution, for example, is a systemic problem involving scientific, economic and environmental issues,” says Koria. “The IDBM is an effort to create individuals who can think outside their own profession because we recognise that breakthrough innovations are often done in interdisciplinary teams.”

## RESULTS

- The programme has significantly enhanced Aalto University’s ties with industry, training 703 students

in 168 company projects with 114 partner companies and establishing a direct recruitment platform for IDBM students.

- Seven to ten per cent of the IDBM projects lead to the development of a real-world service or product innovation, creating major value for the industry partner.
- The university is closer to market developments because its students are engaged with cutting-edge business models, including service design. Many entrepreneurs emerge from the IDBM context.Aalto is now considering replicating the real-life case studies in other courses.
- IDBM helped pioneer multidisciplinary learning at all three universities where it was initially offered, and was a convincing example with a 12-year track record at the time of the Aalto University merger proposal in 2007.
- The IDBM programme has helped evolve university governance through its different incentives and structures. "It doesn't fit into the traditional lines of command at Aalto," says Koria. IDBM management reports directly to the vice rector of teaching.

***Lessons for building multidisciplinary programmes that engage industry***

***1. Create a strategy.*** To attract industry involvement, university programmes must be strongly orientated to industry. That means commitment from the top leadership to breaking down barriers inside the university and within the company. It requires faculty with industry experience. If the partnership involves other universities, they should forge a common understanding before approaching industry***.***

***2. Develop win-win partnerships.*** Companies have to have a real commitment to make these kinds of projects work, so the proposal has to be a win-win situation. "What we offer is essentially to help companies think, says Koria. "One of key problems is companies don't have the time to sit back and reflect. We offer new ideas. They can take them up and implement. We help them to improve their business through these inputs (we don't run their business). Because we offer them value, they are willing to open up their doors – and create a training ground inside the organisation for our students.

"It takes a lot of work to convince companies they get benefits from working with students. I spend 20 to 30 per cent of my time setting up projects with companies. This has to be allowed for – and you need to define from the beginning this is also intended as teaching programmes."

***3. Don't seek to protect IP. "***Many universities want to own any intellectual property developed by students who work for companies," says Koria. "This IDBM partnership is not research for companies. Our objective is to create a situation for real-life learning. We throw away the profit motive. It's not in our interest. Who would want to collaborate if the university owned the IP?"

***4. Communicate the benefits of a new generation of innovative thinker.*** Multidisciplinary teamwork is a vital and sought-after skill in the labour market. Programmes like the IDBM create a window on future recruits that could sharply reduce internal training costs. "Companies may save two to three years of training when

people come in with these capabilities," Koria says. "That's a tangible benefit for the company.

***5. Develop a pool of academics with deep understanding of industry and business experience.*** When it comes to managing industry collaboration, you have to rethink the type of people running programmes in academia, advises Koria. "Most university teachers have no idea what the business world is about. You have to break down academic silos. Normal academics don't have much incentive to do this. They are judged by publications and it's difficult to publish while managing programmes like this.

"The key issue is having people who cross boundaries – you need multidisciplinary individuals who are mentors. The university has to be open to giving people leading positions who normally wouldn't be chosen. You need bridge-builders. That's the bottom line. This kind of collaboration doesn't happen by itself. People make this kind of change happen. If all the key people running the IDBM today would leave, it would fall apart. You have to be constantly on the lookout for people and create incentives for them to grow."

This kind of programme most suits colleges of applied arts and technical universities where publication in academic journals is not priority number 1. But any university can do it if it creates the right incentives. "We dedicate 70 per cent of our resources to teaching and 30 per cent to research. And the research done must be directly useful for the teaching programmes," says Koria. "We take away the academic liberty of researching almost anything and say the balance of resources must be used for teaching. Normally its 50-50. And we have a real mission to engage with industry and society at large, creating tangible benefits through our interaction."

*(IDBM director Markku Salimäki has 20 years of industry experience, an MSc in technology and a PhD in economics. Koria has an MSc in architecture, an MBA in design management and PhD in economics.)*

***6. Develop student communities to overcome silo thinking***. For multidisciplinary and cross-cultural projects, it's vital to create a community among students so they learn to understand and appreciate differences in how others think. "We spend a lot of time doing this – it's intensive in the first year," says Koria. "After that they have a community of practice together. During the first year they learn how people think differently in other professions. We don't want to erase those differences. They are key to innovation. That's why the programme requires people at a graduate level with strong professional background. If everyone is a generalist, no one contributes to new ideas. We're interested in benefiting from the differences."

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CASE 3

## THE ENERGY BIOSCIENCES INSTITUTE (EBI):

*Key interview: Paul A. Willems, EBI Associate Director, Vice President for Energy Biosciences, BP*

The EBI is a ground-breaking strategic research partnership created in 2007 to tackle the application of modern biology to energy problems. The main focus now is on developing sustainable next-generation biofuels and reducing the impact of fossil fuels on global warming. BP supports the institute with a 10-year, $500 million grant. Its partners are the University of California, Berkeley, the Lawrence Berkeley National Laboratory and the University of Illinois at Urbana-Champaign. The institute hosts 60 research groups including 129 faculty members and over 300 postdoctoral researchers and graduate students.

### INNOVATION

BP's desire to bring multiple disciplines to bear on the challenge of creating sustainable biofuels through the EBI forged a new academic field – energy biosciences – integrating biology, chemistry, engineering, environment, agriculture and economics. The institute combines a long-term research vision with a mission to drive step-change innovations that will pave the way for sustainable fuels. It covers the entire value chain, from crop selection and sustainable farming all the way to conversion of crops to fuels. The EBI is governed by a three-person directorate including two academics and a senior manager from BP. The Institute director is a professor in the department of plant and microbial biology at UC Berkeley, the deputy director is a professor of plant and crop sciences at University of Illinois, and associate director Paul A. Willems is technology vice president of energy biosciences at BP. "Rather than [having] a single leader, it's a triumvirate," says Willems. "We have a lot of input on a strategic level, but not on day-to-day implementation. The management team creates the annual work plan and budget. The governance board approves the strategy and budget, but does not have a line-item veto. There's no mechanism for the university or BP to say, 'We don't like project number 17 – take it out.' Everything we do is through influencing and being part of the scientific process as opposed to formal authority."

### RESULTS

- The creation of the EBI has had a major impact on teaching and learning at BP's partner universities, increasing the multidisciplinary studies focus at UC Berkeley and University of Illinois. Energy biosciences was not its own discipline in 2007 when the institute was launched. As talented faculty publish papers and win grants based on their work at the EBI, BP's university partners are starting to develop a formal energy biosciences curriculum, which is an independent endeavour by the universities – something BP encourages but does not directly sponsor, Willems notes.
- The EBI has enabled young and established faculty from various disciplines to become recognised leaders in a new cross-disciplinary field and to start winning federal grants for which they might not

have been competitive before EBI. "For the university, this then brings more research dollars and more recognition for faculty," Willems says. One example: Madhu Khanna, a professor of agricultural economics at the University of Illinois, started applying her expertise to the field of lignocellulosic biofuels. She has since won additional related DOE grants and been called to testify in Congress on the subject.

## LESSONS

***1. Commit to a long-term partnership***. "A 10-year partnership is very important because it puts everyone in a serious frame of mind about the collaboration," says Willems. "Company managers tend to do one- or two-year partnerships, and it ends up getting five per cent of their attention. That's like a hobby. You have occasional interactions, but you don't follow the collaboration closely."

***2. Create time, space and freedom to achieve your partnership's goals.*** The creation of a new discipline and a separate EBI building allowed people to opt into it – that was a key feature. "We didn't have to show up somewhere on campus and make a department do things differently. We had a new space and new people who were self-selecting for doing multidisciplinary work. No one was forced to be in an EBI mode of working. This helped create a positive atmosphere. The students still have deep departmental exposure through professors, but everyone's lab in EBI was next to people doing all kinds of other things. You might be working on a biology aspect of a problem while your neighbour is working on a chemistry aspect."

***3. Build in progress reports to monitor the direction and relevance of the research.***
One major worry for both sides was the fact that academics had to report on ongoing progress to continue their funding every year – a review process which multi-year federal grants typically do not require. This could have been seen as bureaucratic; but in fact, the review process helped accelerate the innovation process. Pathways that did not look promising often triggered new ideas. "It's more a matter of redirection and allowing research to evolve in a new direction in a real-time basis," says Willems. "No one wants to work on a dead-end project just because you wrote the proposal two years ago and you still have one year to go. Typically, this kind of flexibility to change course is not there in other partnerships."

***4. To attract industry, universities must embrace multidisciplinary research***
BP took proposals from teams of universities around the world to ensure they covered all the capabilities needed for the new institute. On the final cut, all five contenders had world-class science, but the UC Berkeley consortium was the most enthusiastic about taking a multidisciplinary approach. "That was a big differentiator," says Willems.

***5. Ensure company scientists and researchers engage with the Institute on a daily basis.***
BP has several company scientists embedded in the EBI and some 50 researchers and managers that connect with the institute regularly. The EBI directors hold a formal quarterly research committee meeting with BP business leadership to highlight what happened in the previous quarter and what's coming up.

***6. Design a clear IP framework as part of the master agreement***. "A master agreement should apply to everything that flows out of the partnership. Otherwise you lose a lot of time to sorting out the same issues over and over. Also, if you want to bring in a partner institution – you just point to the agreement and say, 'take it or leave it.' A framework agreement where you define non-exclusive and exclusivity allows freedom for everyone. Some IP is owned by university. Some is owned by BP and some by the co-inventors. Within its field BP has non-exclusive right for having funded the research – that's the default. For additional licensing fees, it can have exclusive rights."

***7. Universities are not well-suited for doing research that business immediately needs. "***The strength of universities is blue-sky discovery and proof-of-concept where it's an early stage of innovation and there's a lot of work to be done to bring a product to market. Universities can do exploratory research which companies cannot realistically do. When you need the unbounded mindset and capability that a university offers, it's the right choice. If you are too close to the marketplace, working with universities can be an unreliable business proposition."

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**CASE 4**

## AUDI AG – BUILDING A UNIVERSITY INSTITUTE TO FUEL INNOVATION

*Key interview: Peter Tropschuh, Head of Scientific Relations and Corporate Responsibility, AUDI AG*

In 2004, Audi proposed a deep and strategic collaboration with the Technical University of Munich (TUM), through the establishment of a research institute near Audi headquarters in Ingolstadt that would support over 100 PhD students working on technology and innovation issues vital to Audi's competitiveness. The company had recently set a goal of becoming the world's number 1 luxury auto brand, and was seeking new ways to enhance the company's ability to innovate.

The institute brings professors and students close to Audi's researchers, streams innovative new ideas into the company and is a vital pool of future talent. Audi invested in the infrastructure. The university created the possibility for faculty to work closely with Audi. The local government provided a site.

The institute is managed by a strategic steering committee which meets twice a year to define areas of research interest, review progress, address problems and discuss goals. Representatives of Audi's executive board are on the steering committee, including people with technology, production and human resources expertise. Two thirds of the

ideas for projects come from Audi and one third from the university. Each project has to have the potential to improve the company's products or processes.

## INNOVATION

The Ingolstadt Institute of TU Munich established a large-scale strategic relationship between university researchers and Audi, designed for major impact on teaching and learning as well as the company's competitiveness. It extends beyond transactional research projects to create a large competence centre focused on getting cutting-edge technologies to Audi's doorstep. Top faculty and 80 PhD students from TU Munich and 50 from other universities tackle research topics selected for their relevance to global competitiveness in the automotive sector: production systems, quality control, engineering, software, man-machine interface technologies, lightweight construction, new materials and aerodynamics.

## RESULTS

- A steady flow of technology process innovations built into Audi cars and production lines. Current models incorporate advances in lightweight construction, suspension technologies electronics, man-machine interface software. Innovative management solutions adopted.
- Improved competitive edge.
- Strongly enhanced exchange of knowledge. A total of 130 PhD candidates are now working on technical research topics at the Ingolstadt Institute.
- Highly successful recruitment channel. Eighty per cent of candidates stay with the company following three years of work on their PhD.
- Successful replication. Audi has transplanted the university institute concept to China by including Tongji University and to Hungary with the Budapest University of Technology and the University of Györ.

## LESSONS

***1. Define a clear strategy and listen.*** Universities should listen to industry and ask, what does it really need?

***2. Meet and talk regularly.*** "We talk about the good things and the bad things. The important thing is having this personal contact – seeing each other across the table. That's one of the secrets to why the projects are running so well," says Tropschuh. "Cooperations live through people. We want the chance to meet."

III

# PARTNERSHIPS THAT DEVELOP NEW FUNDING STREAMS FOR UNIVERSITIES

**Most industry-university partnerships generate income for the academic institutions involved, but some have done this on a much grander scale and in a nearly self-sustaining fashion. Each case described in this chapter evolved from a special set of interests, goals and strengths among the partners. The lessons highlight the commitment required on both sides to create and manage ambitious large-scale partnerships that provide significant new funding streams to the university.**

CASE 5

## IMPERIAL INNOVATIONS – TAKING A TECHNOLOGY TRANSFER OFFICE PUBLIC

*Key interview: Susan Searle, CEO, Imperial Innovations*

What is now Imperial Innovations Group PLC began in 1986 as the technology transfer office for Imperial College London and became a wholly owned subsidiary of the university in 1997. In 2006, it was registered on the Alternative Investment Market of the London Stock Exchange and raised £26 million in an initial public offering – one of the first university TTOs to make the transition to listed company.

Imperial College's grand experiment in handling technology transfer from a privately listed company so far has produced a sizeable war chest for the university. Since 2005, Imperial Innovations has raised approximately £206 million (before issue costs) from investors. In the five years following the IPO in 2006, the group has invested a total of £83 million, and its portfolio of 78 companies has raised investment of over £300 million.

Imperial Innovations has a technology pipeline agreement with Imperial College London that extends until 2020, under which it continues to act as the technology transfer office for the university and has a right to IP emerging from research. Investors hence are wagering on the future of new technologies developed by the university, and on Imperial Innovation's ability to commercialise them. The group invests in technology spin-outs in healthcare, energy, engineering and the environment, and provides scientist-entrepreneurs with investment as well as operational expertise and assistance recruiting high-calibre management teams.

In January 2011, Imperial Innovations raised an additional £140 million (before issue costs), enabling it to accelerate investment activity, increase the size of its investments and broaden its investment remit to include companies supported by its collaborations with Cambridge Enterprise, Oxford Spin-out Equity Management and UCL Business.

Imperial Innovations' strategy following the 2011 fundraising is to invest larger amounts and maintain its involvement over a longer period of time to maximise exit values. The group focuses on six to ten companies a year, ensuring they have strong boards and management teams and are well capitalised. It seeks to create and seed three to four new companies a year.

## INNOVATION

Imperial Innovations pioneered the notion of raising funds from the stock market to accelerate the commercialisation of the deep pool of new technologies continually being produced by a world-class research university. A key attraction for investors is the close relationship with Imperial College London through its shareholding and commercial pipeline – but the company has gone beyond that to invest in other companies. The Innovations story is unique in taking a technology transfer operation and adding an incubation business and an investment arm.

## RESULTS

- At 31 July 2011, the group's net assets totaled £224.1 million (2010: £91.1 million). Imperial Innovations has generated £20 million in returns from divestments to date.
- In the 2011 fiscal year, Imperial Innovations launched six new companies and invested £35.1 million (2010: £14 million). The portfolio companies raised £129 million in cash and investment commitments. The group's pre-tax profit was £600,000, down from £5.5 million in 2010, as its focus shifted to building the portfolio of investments and holding them longer.
- Early successful investments include the 2010 trade sale of RespiVert, a small-molecule drug discovery company, which generated £9.5 million of gross cash proceeds from an investment of £2 million; and Ceres Power Holdings, a domestic fuel cell manufacturer, which has so far realised £4.8 million from an investment of £0.65 million. In addition, a £1.5 million investment in obesity drug developer Thiakis has the potential, subject to milestones, to return £16.1 million, following its sale to Wyeth in 2008 (now Pfizer) for £99.4 million.
- Fundraising has enabled the group to increase the size of its investments and leverage them. In 2011, Imperial Innovations led a £40 million funding round for Nexeon, a battery materials and licensing company, investing £15 million alongside existing investor Invesco Perpetual.

## LESSONS

**1. Universities can develop significant funding from the investment community by rethinking the traditional TTO model.** Imperial Innovations has gone beyond the traditional TTO role in seeking to identify promising new technologies and commercial opportunities for Imperial College London. In August 2011, for example, the group's investment team co-founded a spin-out based on research at GlaxoSmithKline (GSK), after convincing GSK that University College London had deep expertise in the same technology which could support the new company. The spin-out, Autifony, is developing treatments for

hearing disorders together with University College London's Ear Institute. Imperial Innovations committed £5 million and holds a 33.6 per cent stake. "The original idea and technology does not come from the university. But we believe the university has more insights on how to progress those ideas," says Imperial Innovations CEO Susan Searle. "The benefit is that the university gets a funding stream (from the start-up), and it gets access to interesting technology from which the science could progress.
"The old model where the academic comes up with an idea and you find a CEO does work. But it's a very linear approach and restricts you to only one aspect of what the university can offer," says Searle. "We've tried to experiment more. We look at where there is deep research competence, where there are emerging gaps and what the market needs. It's a different approach – it's a market-led approach that moves away from thinking of the university as just an idea generator. We see the university as a big source of expertise." At the same time, Imperial Innovations now looks across four UK research universities to develop the strongest research collaboration teams possible for its companies. Several spin-offs based on research at Imperial College, including Plaxica and Circassia, are now working with researchers at Oxford University. "Different scientists are all trying to understand the same mechanism," says Searle.

**2. To create large companies out of spin-offs, universities need to accompany them further.** Once university spin-offs are officially incorporated, many TTOs typically congratulate themselves on a job well done. But the toughest challenges for a newly formed start-up lie ahead. "The key challenge is how to take spin-offs and scale them. How do you help CEOs deliver?" says Searle. "You've got to think about growing a pool of industrial partners and sponsors [for them].

"I hate the word 'spin-out' because it connotes something small," says Searle. "We see seriously good companies emerging. Circassia has raised £60 million – the third largest funding round for a private European biotech company in 15 years. These companies can grow into future industrial employers. We think about how to create value and build companies." Venture capital companies have a fixed timescale for a return on investments, but Imperial Innovation's structure allows the company to take time to build larger companies.

**3. Industry-university collaboration works best with big framework agreements based on broad principles.** "Too often people view partnerships in black and white. You need to sit around the table and talk about the opportunity and what each party brings. Each side has to be rewarded. Get a working framework that everyone signs. You need capable people who take a sensible approach. People get too hung up on ownership of IP instead of the outcome, the incentives and rewards for all parties. Establish the broad principles and then as situations crop up, just decide how to deal with them. When it comes to negotiating IP, it's all about being practical and pragmatic – and not getting hung up on rules."

**4. Entrepreneurs-in-residence can help a TTO scout more effectively.** Imperial Innovations encourages partnerships that are more exploratory about market opportunities and encourage researchers

to apply their science to work on market problems. “We bring in teams to work with scientists and we often provide them with money,” said Searle. “We also retain entrepreneurs-in-residence for a year to find and build an opportunity to launch a new business. Venture capitalists have always used entrepreneurs in residence or venture partners to source new opportunities but they mostly work with existing companies. We said, ‘Let’s take entrepreneurs to look at what the scientists are working on.’ ” You put these people together with academics and things come out of discussions.

**5. Managing a publicly listed TTO requires huge resources and commitment from the university.** Replicating Imperial Innovations’ achievement at another university would be “an enormous task” says Searle, who admits the approach may not transfer easily. “It’s a complex story and it has taken a long time to build the business… What we’ve done is quite unique – it took a lot of time, resources, and investment.” One of the biggest challenges is building a team with the right skills – including the blend of business development experience and scientific expertise to identify opportunities. “Today we are an early-stage investment business. We have an integrated technology transfer office creating opportunities and providing knowledge and insight on how best to work with a university.” At the same time, Searle says European TTOs have come up the learning curve and are more effective today. A number of successful approaches developed by Imperial Innovations, such as playing a more active role matching industry research interests with the university’s science, don’t require listing the TTO on a stock exchange. TTOs can develop new funding streams by “turning the telescope around” and engaging with industry. “Identify the top 50 technology companies [in a region close to the university], sit down with each CEO and ask what he or she needs to grow the company,” says Searle. “You’d get a lot of answers and requests. That’s really where you should be looking… The approach is to look at companies and what we can do to make their life easier. The university piece is part of that – technology companies need a relationship with universities.”

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# IV

# PARTNERSHIPS THAT REINVENT THE ROLE OF THE RESEARCH UNIVERSITY IN THE KNOWLEDGE TRIANGLE

**A handful of pioneering universities and companies in the US forged novel, large-scale strategic partnerships in the 1990s. The following two cases, one a matching-grant programme and the second a multidisciplinary research institute, sought a step-change in ways of collaborating. Both projects were given top priority by the University of California and the State of California, and were aimed at helping transform the university culture and mission, intensifying its role in service to the economy through partnerships with industry that drive innovation.**

**CASE 6**

## UNIVERSITY OF CALIFORNIA'S INDUSTRY-UNIVERSITY COOPERATIVE RESEARCH PROGRAM (IUCRP)– DEFINING A NEW ROLE FOR THE RESEARCH UNIVERSITY

*Key interview: Susanne Huttner, former Executive Director, IUCRP; former Associate Vice Provost for Research, Office of the President*

In 1996 the University of California (UC) System launched an ambitious new approach to collaborating with industry. Under its Industry-University Cooperative Research Program (IUCRP) it used matching grants to catalyse hundreds of strategically focused partnerships, dramatically increasing the number of faculty, students and companies participating in such joint collaborations. The approach promoted a new research and education paradigm, and created an important new source of research funding across UC's nine campuses.

The IUCRP's matching grants, called the UC Discovery Grants, invested $20 million a year from the State of California and UC in faculty research projects on the condition that each grant was matched dollar for dollar with funds from a California R&D firm. The IUCRP cast a wide net across five fields of science and engineering. The research proposals were similar to US NIH or NSF investigator-initiated proposals and the work was early stage (basic through proof of concept). All funded projects supported student researchers.

The grants bridged the gap between the university research community and California companies, advancing the scientific knowledge base, intensifying the relevance of research and education programmes, and accelerating the application of new discoveries in the economy.

At the outset, the university and state aimed to do the following:

- Expand industry access to the university and increase discovery research that could form the foundation for entirely new technologies and products
- Leverage industry, state and federal R&D investments
- Build a diverse science-and-technology portfolio relevant across a broad array of R&D-intensive industries
- Expose faculty and students to how R&D is planned and managed in the private sector
- Promote high-risk/high-impact research with rigorous quality controls
- Create R&D leaders, develop a highly skilled workforce, and expand technology transfer
- Tackle major social problems including health, clean air, water, energy, manufacturing and public safety.

## INNOVATION

The IUCRP sought to create a large-scale transformation in the way the university's tripartite mission for education, research and public service was pursued. It set out to rapidly increase the number and quality of collaborations between UC faculty, students and industry and to focus those collaborations on strategic areas of research to benefit the economy. At the same time, the IUCRP aimed to change the university culture and create greater openness to innovating with industry by building a wide and deep pool of academics who were skilled at working in partnerships. "We aimed at making it very clear that working cooperatively with companies on compelling research problems was appropriate and essential to the university mission," says Huttner.

## RESULTS

- ***A new and large funding stream for university research.*** From 1996 to 2007 the IUCRP brought in $450 million in state and industry research funding to hundreds of faculty laboratories in all nine UC campuses. The Discovery Grants supported more than 2,100 research assistantships for graduate students working for an average of 18 months on a sponsored project.
- ***Companies drawn into earlier-stage research, with enhanced R&D performance and job creation.*** The investment risk for companies was partially offset by state matching funds and the quality control provided by faculty peer review of proposals and progress reports. Ninety six percent of companies responding to a survey reported that participation enabled them to undertake something they could not do in-house due to, for example, insufficient expertise, financial resources, or research infrastructure. These firms created five thousand net new jobs in California between their first matching grant and 2003.
- ***Joint research collaborations between faculty and companies that had never before worked together.*** In the first seven years of operation, the UC Discovery Grants engaged 353 companies in more than 595 research partnerships. Some 40 per cent of companies sponsoring grants had not sponsored research at UC before engaging in an IUCRP matching grant,

according to those who responded to a UC survey of participants. About 36 per cent of UC researchers who responded to the survey had not participated in industry-sponsored research previously.

- ***Expanding circles of collaboration.*** Eighty-four per cent of UC researchers said their experience encouraged them to build research relationships with other companies.
- ***Enhanced survival rate of start-ups that formed partnerships with university researchers.*** Of the 51 sponsoring companies with 10 employees or fewer, 84 per cent were still in operation at the time of the survey. These young firms reported that participation helped them raise capital, recruit key personnel and accelerate R&D.
- ***Enriched career paths of students.*** Student experience in industry-relevant research programmes made them attractive recruits for companies and some students started their own firms. The programme seeded the future R&D leaders.

## LESSONS

***1. It's hard to get companies to invest long term. So communicate in their terms while creating incentives grounded in the university mission***. Strong ties and continual communication on key research areas can convince industry to commit to continual cycles of research investment. Set up an advisory board with top-level industry executives and university research experts to determine priority targets for research. "We worked with the companies and asked them about the greatest R&D challenges that might be addressed through a joint effort with university researchers," said Huttner. "We explained to them that we are in it for the long haul." That helped the university and industry partners agree on five broad fields and attracted strong company partners to begin to fund the matching grants. As the matching grants attracted top faculty, the IUCRP triggered a growing dialogue within the university and with more companies.

***2. Tackle the culture gap on campus – create incentives and bridge the divide.*** One of the best incentives for academics is a new opportunity for funding which enhances their research goals and career. "We identified the target-rich areas by doing cooperative planning between university and industry communities. We came up with a strategic focus that was of mutual interest – defined by both communities. By talking about it, they started to learn about each other," Huttner says. "We also did the usual sorts of things: we hosted faculty research events on campus and invited companies, participated in industry events and organisations, and shared databases and mailing lists. That all worked well. We also hired staff with direct experience doing research in university and industry settings, and gave them the job of looking for partnership prospects and helping them develop UC Discovery Grant projects. The matching grants were an opportunity for those more entrepreneurial academics to try something new. For other faculty, however, it was hard at first to explain that this wasn't simply about bringing more grants to the university to support more research, but that it was about enriching the context for research and making it more relevant and applicable in California – and,

in the process, educating people in fields fundamentally important to the economy. The most important factor in convincing academics to enter into joint research programmes with industry was the opinion of their peers – colleagues who had had positive experiences introduced them to the programme and gave them advice on how to work effectively with companies. There were, of course, countervailing forces and disincentives inherent in university culture and traditions. An important one, especially for young faculty, is the failure of the tenure and promotion process to recognise and give credit for the additional effort invested in industry-university cooperative research, invention licensing and participation in entrepreneurial startup firms."

***3. Select managers who can cross university-industry boundaries.*** Most partnerships don't work well, according to US National Science Foundation (NSF) studies. They require institutions to do something they haven't done in the past. "It's a management challenge," says Huttner. "Most faculty gained experience in competing for and managing federal research projects while they were in training, but they have not learned how to develop and manage cooperative research programmes. There is a gap in the needed understanding, experience and skills.

"You need to ensure that academics and industry researchers work together to develop and meet agreed upon milestones and timelines or to revise them in a timely way, as needed. Recognize that companies will only co-fund research if it is relevant to their priorities and goals, and those priorities and goals can change over time. Ongoing communications is essential. Ensuring accountability while streamlining administrative and financial requirements is also essential. While most programmes fail because the people running them don't have the necessary knowledge and skills, the reason the IUCRP was successful is because we had enough people who had done it before and understood these things."

4. Leadership, vision and resolve are essential. Partnering with industry requires a long, sustained commitment and focus. University presidents face incredible pressures on many fronts. If they do not make industry collaboration top priority, they will end up with series of incremental initiatives and short-term partnerships, and little or no evidence of substantial impact. University leadership has to lay out a vision for the institution's role in innovation in the 21st century. "It's a revitalised view of the tripartite mission and not just about teaching, research and public service. It's about higher education's growing role in fuelling the economy," says Huttner. "Institutional innovation to accomplish this new mission is absolutely critical.

"We had very strong backing from University of California President Richard Atkinson – that was so essential. If the university president hadn't made this a priority in his strategic planning, speeches and budgets, we would have run into a wall. The campuses would not have developed the resolve to stand behind the goals and address the challenges that evolved over time…such as those associated with more complex research grants, industry relations, conflict of interest and technology transfer. We also would have never gotten state

legislators to invest the additional money in university research. They thought they were already providing adequate funding. Atkinson kept telling the story – he pointed to Silicon Valley and San Diego, he brought in companies – and then the Legislators and Governor came along, as well. Industry-university partnerships became a State priority for building the economy."

***5. Aim at a broad spectrum of outcomes. Build an active role for the university in serving economic growth, not just commercialising IP. Measure outcomes that reflect factors critical to industry competitiveness. "***IP management is important to get right and it protects interests – but it does not reflect industry-university relations in any robust sense. Too often IP is seen as *the* means for industry-university relations. Instead, engage the university more broadly in providing solutions for the economy. Companies want to know what's next – not what's already done. That's where universities need to position themselves.

"In judging research partnership outcomes, don't ask how many jobs were created or how many new businesses. Those are the wrong questions because research is incremental and impacts are difficult to tease out of company R&D programmes (which are complex and generally confidential). Consider, instead, the critical issues (of competitiveness) that companies have to grapple with every day. Collaboration can't be measured. It has to do with leadership skills and risk-taking."

***6. Build an administrative and funding framework that is familiar to faculty. "***Remember that you are asking faculty to do something new and potentially risky. Don't start with exotic, all-new grant solicitation and administration mechanisms. Try to keep processes well grounded in experience and proven effective mechanisms."

***7. Use peer review to build in quality control. '***Rigorous peer review offers the business community a trusted stamp of quality control for the research programmes in which they co-invest. It increases the confidence of company decision-makers and, for young firms, impresses their prospective investors."

***8. Engage university leaders in the transformation.*** "Fostering champions among university leaders is essential. As important is engaging them in widening networks of business and other leaders who can help them develop the value proposition and explore how to build leadership and management for institutional change."

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**CASE 7**

## KAROLINSKA INSTITUTET – GOING FOR A UNIVERSITY-WIDE STRATEGY

Seventeen years ago, Karolinska Institutet was like many European universities: venerable, august and slow at driving new technologies out of lab to market. The innovation revolution that occurred under Hans Wigzell, its radical former rector, provides a key lesson for other would-be reformers: the entire system must promote innovation.

Karolinska Institutet is a pillar of the Swedish establishment. For generations it has trained the nation's surgeons from its privileged position in northern Stockholm. More famous for the prestige of awarding the Nobel prize for medicine rather than its best known invention – the pacemaker – the university seemed unable to leverage its strong assets. But a cultural change spearheaded by Rector Hans Wigzell in the 1990s has catapulted Karolinska Institutet into the top leagues of Europe's most innovation-driven universities. It produces a steady stream of spin-outs, new products and entrepreneurial graduates. Key to Wigzell's success was the introduction of new management and a system-wide approach to fostering innovation.

Karolinska Institutet's innovation system has four main elements: the Innovation Office, Karolinska Institutet Innovation, Karolinska Development and the Unit for Bioentrepreneurship.

## LESSONS

***1. Build commercial competence into the university governance system.*** Karolinska Institutet Innovation was set up to promote commercial-minded research and partnership with businesses. For Bo-Ragnar Tolf, its director, this broad remit can extend from evangelising among colleagues to matchmaking companies with researchers. When researchers think they have a market-ripe innovation, the next step is to consult Karolinska Institutet Innovation, which offers advice and project management at this early stage.

***2. Raise funds for spin-offs.*** Karolinska Development, the university's spin-out arm, floated on the stock market last year, raising €63 million in addition to some €140 million in private funds already raised. The funds will ensure a portfolio of over 40 companies moves through the critical first two phases of product approval, creating a 'product pipeline' to quickly and efficiently groom spin-outs for sale to the pharmaceutical industry, which will return dividends to Karolinska Development that can be reinvested. Karolinska Institutet researchers (who under Swedish law, hold the patent) are encouraged to serve on the board of the spin-outs rather than be active in the business team. In the words of CEO Torbjorn Bjerke, this means that both sides can "focus on doing what they do best". It provides an incentive for researchers to innovate without requiring them to become entrepreneurs.

***3. Go for excellence***. Karolinska had a key advantage in appealing to industry in an innovation tandem – it is one of the best medical schools in Europe. That has made it easier to attract funds.

***4. Encourage and leverage ties to local industry.*** Karolinska Institutet has benefited from deep ties to the successful and close-knit Swedish biomedical industry. Karolinska Development was able to draw on a group of investors willing to provide seed capital with long-term commitments – a reflection of the trust engendered by long collaboration.

***5. Embed students in industry.*** The Masters in Bio-Entrepreneurship (or MBE) at Karolinska Institutet is an MBA programme designed to appeal to science graduates who prefer a business suit to a lab coat and is focused specifically on

the biopharmaceutical sector, training people for pharma industry jobs and biotech start-ups. Its founder, Carl Johan Sundberg, describes it as a "tailored programme on how to make practical use" of these students' scientific background in the commercial side of the life sciences industry. The programme's key innovation is extensive embedding of students in companies and businesspeople in the curriculum. Industry executives are invited throughout the two-year programme to teach, advise and host students. This collaboration starts in the classroom, where businesspeople deliver guest lectures on the nuts and bolts of the business: on market analysis, or business development.

The programme goes beyond textbooks and gives students a toolbox of practical skills. To this end, small teams of students take part in three internships at various companies in the Life Sciences industry. For example, Erika Bulger spent six weeks at IMS Health working on an internal report on the restructuring of the Swedish healthcare system. Now at a German biomedical consulting firm, she says that this practical experience helped complement the theory she learnt in class, "bridging the gap" between her training as a scientist and the commercial reality. The MBE offers students practical skills that make them more employable, and a set of personal industry contacts. Companies get a project done that they wouldn't have time to do themselves, and access to new talent. Hans Andreasson of SLS Invest noted that small businesses have little coaching capacity, so students must work independently. The programme is designed to encourage this independence through team internships where students tend to solve problems among themselves and contact their supervisor less. Incorporating a spell in business as a key part of the curriculum is becoming ever more common in MBA programmes around the world. What distinguishes the MBE is that it is tailored to science students who want to work in the bio-medical industry. The importance of placements to the programme is inspired by the 'Team Masters Project' at the Keck Graduate Institute in California, which was first started in the late 1980s and is now widely respected by students and businesses. Sundberg intends to increase the number of companies that are 'repeat customers'.

**CASE 8**

## CALIFORNIA INSTITUTE FOR TELECOMMUNICATIONS AND INFORMATION TECHNOLOGY (CALIT2): A PARTNERSHIP TO SHAPE THE "UNIVERSITY OF THE FUTURE" AND SPARK ONGOING INNOVATION

*Key interview: Larry Smarr, director of California Institute for Telecommunications and Information Technology (Calit2), University of California, San Diego*

In 1999, the State of California was sitting on a financial surplus, courtesy of the Internet bubble. Governor Gray Davis wanted to put the money to work in a way that would support innovation and the California economy. He suggested a partnership involving the state, the 10-campus University of California and industry that would boost cooperation among the parties, increase the benefits to society of the public university system and "make a down payment on California's future," as Davis noted at Calit2's 10th anniversary

celebration in 2010. The president of the University of California at the time, Richard Atkinson, said the proposal could create the "university of the future".

"He wanted to do something with that money that would keep on giving to innovation and the California economy," said Larry Smarr, director of Calit2. The ten campuses have faculty who are among the best in the world, he said. "But they didn't have an institution to provide consistent support for cross-disciplinary work and that engaged industry more naturally with the university."

The following year, Calit2 was formed as one of four new research initiatives created by the State of California, the University of California and industry. At the core of Calit2 are the University of California's San Diego and Irvine campuses, located an hour's drive from each other. The state legislature agreed to provide $100 million in capital construction funds for each of the four institutes. The state mandated that for each $1 it contributed, the institute had to raise $2 of industry and federal funds. Now, a decade later, the Calit2 initiative has a faculty of 600 from fields as diverse as telecommunications, nanotechnology, digital cinema, art and environmental monitoring, along with some 300 industry partners spanning the globe.

To Smarr, the scale of the application areas and underlying technologies under one roof, as well as an institutional structure that exists in very few other places, caused what he called a "cultural revolution" among researchers. "We drive cultural change and a set of services the campus didn't have before," he said. "We have Calit2 as a platform to launch public-private partnerships. It [innovation] doesn't come because of an individual professor or individual department or an individual school. Calit2 has 1,000 researchers from 24 departments between the two campuses and 170 staff. We are set up to handle things [on a large] scale." Undergraduates also have access to the multidisciplinary activities.

## KEY INNOVATION

The multi-stakeholder partnership allows Calit2 to cast a broad net and take on large, multinational partnerships, while at the same time focusing on individual students or companies. It also has technical professionals with industry expertise who return to academia, and who can lend expertise for as little as a few months on a specific project, then go on to another project. Companies have access to both professors and the technical professionals.

"A key innovation is providing this persistent brainwork across two campuses in disciplines ranging from engineering to arts," Smarr said. "It is an institutional structure that very few places have."

Despite its large structure, Calit2 has stayed nimble enough to adapt to changes. While its initial funding came from a dot-com surplus, companies subsequently downsized. As Smarr explains, "We got organisational pledges from industry just before the market bust, and then we went out to collect the money as the NASDAQ fell from 5200 to 1200. Companies actually disappeared during the time they pledged the money. So we had to work with our industrial partners to figure out how to keep

their interest in university research while they were undergoing a life-and-death struggle in their own company." Calit2 had to reaffirm commitments one by one. "We don't have gold, silver, or bronze status with fixed contribution amounts," Smarr said. "We worked with the companies, stretching payments, reexamining agreements. Most companies stuck with us. It really was a partnership." The longevity of the founding partnerships and new projects are a barometer of success.

Companies join the partnership to get access to university research, perform research they cannot do themselves, and to have their technology showcased in university research projects. According to a Harvard Business School case study on Calit2 published last year, the president of AT&T, in his supporting letter for the institute, wrote: "Calit2 provides a platform for components manufacturers, software innovators, device makers, and telecommunications providers to work together creatively on issues such as availability, quality of service, seamless operations between wired and wireless devices, and policy issues such as privacy." The study also quoted Henry Samueli, founder of networking products manufacturer Broadcom, as saying: "As industry has become increasingly competitive, companies need to focus on near-term innovation that can be brought to market within five years. We have come to rely on universities for longer-term research. That is the sweet spot of Calit2."

## RESULTS

- Development of horizontal links among university departments to foster multidisciplinary studies
- More than 25 spin-outs launched from the university research
- Establishment of the first nanotech cleanroom facility on campus and in San Diego. It is shared with more than 60 companies, which pay hourly fees to use it or to receive training on use of the equipment. Revenue has grown 25 percent compounded annually. As Smarr explains, companies are outsourcing everything that is not in their core competency.
- More than $100 million in funding from over 300 industrial partners since 2000, according to the Harvard study, plus federal research funding of more than $600 million for 570 federal grants
- Calit2 has helped researchers win nearly 1,000 federal, state, not-for-profit, industrial and international grants to date. "That is unbelievable," Smarr said.

## LESSONS

***1. Treat companies as individuals and as partners.*** This approach can keep partners with short-term financial hiccups investing long term, and build trust in the relationship.

***2. Make sure everyone understands intellectual property.*** Calit2 is part of the University of California, which has explicit IP rules. "We make sure the company knows our rules. To engage with us they have to abide by those rules," Smarr said. "They complain a lot about the rules, but we work with them and we have never lost a partner due to those rules. My advice to them: choose how you interact with us so

the outcome is what you want."

***3. Know your partner's needs.*** Companies don't like projects that do not generate internal support in their company, Smarr said. "In sponsored research we put technical professionals and professors in a room with companies till they agree both sides will get something out of a project. Then they come out and bring it to management." He said such a bottom-up approach to projects works better than a top-down one.

4. ***Look for research results to keep on giving.*** For example, CineGrid is one of the first major research collaborations at the UC San Diego division of Calit2. The five-year-old project focuses on next-generation 4K digital video that has four times the resolution of today's HD video. All major Hollywood studios are part of the project, which essentially will allow for a global 24-hour digital movie production schedule. "It costs $1 million a day to make a movie," Smarr said. "Bits follow the sun around the world, so it lets your day be 24-hours long." The movie Avatar, for example, used 800 computer graphics specialists all over the world. The Netherlands CineGrid group in Amsterdam streamed a live opera with 4K resolution at 0.5 gigabits per second from the Holland Festival 2007 to San Diego, the first successful demonstration of trans-Atlantic streaming over photonic IP networks of 4K digital motion pictures and 5.1 surround sound. "Once we had debugged how to stream the digital, high-resolution video of the remote opera to Calit2, we experimented with how this could be interesting to science, such as streaming visualisations of supercomputer simulations of tornadoes. Another example: the US Navy was interested in using a 4K camera on blimps for surveillance and streaming the resulting video.

Calit2 is now working on managing global digital workflow. Said Smarr: "None of these companies [partners], including the studios, have a global optical network in place to support workflow in this digital world." They now plan to create a public-private partnership to look at IP workflow on the Global Lambda Integrated Facility, which connects Calit2 with innovation centers worldwide. "This is a causing radical rethinking of how to distribute work in the film industry."

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# V

# PARTNERSHIPS THAT GO STRATEGIC

**Strategic partnerships have to start somewhere. And they usually begin small and decidedly non-strategic. Of course, how can you tell whether your deal has the potential to go strategic, or wither and die? Therein lies the skill of the managers.**

**CASE 9**

## IBM-ETH ZURICH

*Key interview: Matthias Kaiserswerth, Director and Vice President, IBM Research, Zurich*

Decades of research collaboration between ETH Zurich and IBM led to the creation in 2011 of the $90 million Binnig and Rohrer Nanotechnology Center, the centrepiece of a 10-year strategic partnership in nanoscience between IBM and ETH Zurich where scientists will research novel nanoscale structures and devices to advance energy and information technologies. The new centre is, according to IBM, the first time that industry and academia have created shared research facilities in Switzerland.

The IBM-ETH Zurich nanotechnology centre is a state-of-the-art facility for exploratory research and is not a production or pilot line with fixed processes or wafer sizes. One goal of the partnership is to attract and foster top nanotechnology talent in Europe by investing in leading-edge exploratory research. Scientists and engineers from IBM and ETH Zurich will pursue joint and independent projects ranging from exploratory research to applied projects, as well as generating knowledge about the scientific foundations of nanoscale devices at the atomic level.

## LESSONS

***1. Set up broad framework contracts.*** Relationships between the two organisations developed considerably during the negotiations over the new centre. For example, they took the opportunity to create a set of framework contracts for joint projects. "It makes it very easy for our researchers to meet with their counterparts at ETH to negotiate. They can just pull out a template. We don't spend any more time with lawyers negotiating," says Kaiserswerth. It helps, he adds, that ETH has a realistic understanding of the value of intellectual property rights. "ETH accepts that industry is in a better position to get value out of patents."

***2. Devote time and leadership to partnerships.*** It takes work and leadership from the top to create and maintain good relationships between companies and universities. Kaiserswerth says that IBM and ETH have forged much stronger links over the past decade, thanks to both sides putting more effort into the partnership.

Kaiserswerth credits the presidents of ETH with leading the way on the university's side.

***3. Long-term partnerships generate the largest benefit.*** The 10-year research partnership underpinning the Binnig and Rohrer Nanotechnology Center crowns decades of collaboration between IBM and ETH. IBM first set up a research laboratory in Switzerland in 1956 and the company cites the presence of ETH Zurich and other universities as a reason for choosing Rüschlikon on Lake Zurich in 1962 as the home of its European Research Centre. Swiss physicist and Nobel prizewinner Heinrich Rohrer studied at ETH Zurich before eventually joining the IBM Research Lab in Zurich. "The opportunity to see each other regularly is very helpful," says Kaiserswerth.

The nanotechnology centre is named after two IBM researchers who received the Nobel Prize for inventing the scanning tunnelling microscope at the IBM Zurich Research Lab in 1981. In 2001, IBM and ETH Zurich opened the Center for Advanced Silicon Electronics. In 2003, along with Credit Suisse, they formed the Zurich Information Security Center. Scientists and engineers from IBM and ETH Zurich work together in the centre and on their own projects. Three ETH professors and their teams have moved into the new building and will conduct part of their research in nanoscience on a permanent basis. The building cost $60 million with $30 million for tooling and equipment which, along with operating costs, are shared by the partners. Together they employ staff and share the costs of some of the key equipment. IBM and ETH also work together on various aspects of computing. For example, the Aquasar project studies "green computing". IBM, ETH Zurich and other partners built a new type of supercomputer cooled by hot water. The heat from the computer heats buildings at ETH.

***4. Take a win-win approach to partnerships.*** Both sides benefited greatly from the ability of ETH to join in the project. The university's involvement and its ability to share the costs made it easier for Kaiserswerth to sell the idea of the new laboratory to IBM. Because IBM has land already earmarked for expansion at the Rüschlikon research centre, it could design and build the new facility much more quickly and cheaply than if ETH had tried to go it alone.

***5. Long-term partnerships are the ideal platform for impact on teaching and learning.*** There is a constant flow of people between the company and the university. IBM managers teach at ETH, while students from the university work on projects in the company's laboratory. "They get to give their students a good idea of what it is like to work with industry," says Kaiserswerth.

**CASE 10**

## SKF GROUP-UNIVERSITY OF CAMBRIDGE

*Key interview: Alan Begg, Senior Vice President, Group Technology Development, SKF Group*

Swedish multinational SKF Group has developed five university technology centres since 2008 as part of a move towards highly strategic, long-term collaborations on core technologies. The centres are modelled on a concept pioneered by

Rolls Royce in the 1980s, which focused on strategic alliances with universities as opposed to a plethora of ad hoc research projects. Begg, who heard first-hand about the programme's success from Rolls Royce executives, was intrigued by the notion of building more productive alliances with university partners. "We had hundreds of relationships with universities but not much focus," says Begg, who launched the university technology centre programme at SKF.

Building on a long, successful research relationship with the University of Cambridge, in 2009 SKF established a University Technology Centre based in the university's materials science and metallurgy department. Professor Harry Bhadeshia, a world expert in the physical metallurgy of steels, leads the research.

Under the terms of the partnership, the University of Cambridge is conducting both pure and applied research, with SKF providing funding, technical expertise and practical knowledge. Together, the two organisations have the goal of advancing the knowledge of the physical metallurgy of bearing steels, and to use it to drive the development of new and improved bearing products.

Researchers at the SKF University Technology Centre are concentrating their efforts on ways to manage the detailed microstructure of steel, to enhance its bearing properties. They are also investigating ways in which modifications to the composition of steel can enable complex operational demands to be optimised, while predicting material performance relative to the steel production and heat treatment processes.

Other SKF university technology centres are located at Imperial College London, Chalmers University of Technology and Tsinghua University in China. They focus on friction, wear and lubrication, sustainability management, sensorisation and condition monitoring and polymeric materials.

## LESSONS

***1. Companies who develop strategic relationships with universities may deepen research ties through their university work and decide to innovate together.*** Both SKF and Rolls Royce have set up separate strategic research partnerships with Cambridge focused on materials research – and that is bringing them closer together. "SKF's relationship with Rolls Royce has been transformed in the last four to five years partly because of our university relationship with Imperial. We're moving from a standard customer-supplier relationship to much more of a partnership with Rolls Royce. Their interest and desire to work closer with us is driven in large part by what's developing at Cambridge in our materials science research. SKF has a team of seven people there, and Rolls Royce (which has its own technology centre at Cambridge doing materials research) employs a PhD alongside us."

***2. Be selective: Develop strategic partnerships.*** "It's got to be based on a kind of complementary relationship where companies go to university to do something they can't do themselves," says Begg. "Many companies are seek to harness universities as a cheap source of research – I've done it myself – and it's disappointing. Academics are not employees and don't always do what you want them to do.

"Companies should engage universities because [they] want their ability, creativity and their different mindset on the world. That's the approach to having a very successful relationship. This is true with our engagements at Cambridge and Imperial."

***3. Encourage a two-way exchange.*** "Our relationship with Imperial is unique. Our former chief scientist, Stathis Ioannides, worked for us for 30 years. During at least 20 of those years he was a visiting professor at Imperial. He retired about three years ago but still works actively for us as consultant and supports our research at Imperial. Ioannides has been important for us in driving the collaborative work we did over the years with Imperial. He supervised our projects there. In any university relationship it's important to get the coordination working well – someone who understands both sides. You get out of a university relationship very much what put into it."

**CASE 11**

## IBM-IMPERIAL COLLEGE LONDON

*Key Interview: David Gann, head of Innovation and entrepreneurship and Deputy Principal for Research and Business Engagement, Imperial College London.*

Gann is in charge of Imperial College's strategic relationship with IBM, working closely with them in the Digital Economy Lab – tackling cross-faculty research on systems and services innovation for the digital economy. He also leads a large portfolio of research in collaboration with firms in design, manufacturing, engineering, construction, ICT services and healthcare industries. He directs the EPSRC Innovation Studies Centre at Imperial College and co-founded Design London.

### LESSONS

***1. Understand the different types of partnerships.*** Nine years ago when Gann moved to Imperial College London from the University of Sussex, a requirement for funding his work was collaborative partnerships with industry. "We established a very good advisory board which included several captains of industry. They said we couldn't partner with everyone, and that we had to make strategic choices. They also made clear that different kinds of partnerships are beneficial in different ways.

"We put in place three-tiered relations: Strategic, operational, and transactional. They are all important with us. We have seven to eight strategic partners – that means they influence research and the results influence the company's strategy. Operational partnerships involve a research project with a division or particular R&D lab and can run for several years. For this kind of alliance, professors don't need to know the heads of the company. (His group has 100 operational partnerships.) Transactional alliances include short-term collaborations such as an executive teaching a course, joint events or a student doing a stint in a company. We have a few thousand companies working with us in this mode.

***2. Don't overlook the benefits of non-strategic partnerships – they can grow and develop into strategic partnerships over time.*** Imperial College and IBM worked together for some 20 years on

operational projects before the alliance became strategic. "It was five years ago that we decided to create a college-wide strategic partnership," says Gann. "We took time to get to know IBM. One of their chief technology officers is an Imperial alumnus. He's grown in seniority and is now president of the IBM Academy – the most senior group of IBM scientists and technologists. We decided to create a partnership and set up an executive team. I'm the partnership executive for Imperial College – and we have other faculty representing academic work across the College. The IBM team includes counterpart experts from different sides of its business. We meet every two months to develop and manage the relationship. The executive team has enabled us to deepen our relationship. We have a memorandum of understanding to work in certain fields and a joint agenda. It covers topics from deep research in science to business models in the Business School and executive education programs.

"The relationship has deepened over the years. I work with some of the senior executives in North America as well as the former chairman of IBM Europe, who now chairs our Digital Economy Lab advisory board. So there is strong engagement at all levels. We enjoy a vibrant and deep relationship. We produce an annual report on the relationship and explain how it's moving forward. It's managed as a proper partnership.

"We've got arrangements like that with several other companies. It's important not to just let alliances evolve unattended, but to manage them in a way that allows both partners to gain the most from the collaboration."

***3. Academics driving the partnership need regular access to top management.*** To be a good strategic partner for industry, you must ensure academic leaders have good relationships with people on the company's main executive board. You need a relationship that is senior enough to allow strategic issues to emerge and to be dealt with so that research and teaching have sufficient resources. "Secondments are very important – in both directions," says Gann. "Universities should use adjunct professors from industry. We've learned a lot about how these relationships work. You have to work at crossing the cultural chasm."

***4. Select a handful of strategic partners.*** Strategic partnerships are time consuming. Professors can only have a small number of meaningful relationships with company board members.

***5. Choose the right people.*** "It all boils down to interpersonal relationships, trust and appreciating the difference between what universities do and what companies do. You can maintain different cultures while being prepared to work together. If universities try to become too corporate they may lose the very essence that companies come for in the first place. Good relationships result in positive outcomes from the creative abrasion that exists by bringing two different worlds together. If you do that, you can grow together."

**CASE 12**

## GE GLOBAL RESEARCH, MUNICH

*Key Interview: Carlos Härtel, Managing Director, GE Global Research, Europe*

GE Global Research in Munich, Germany is one of five worldwide research centres

set up by the US multinational. It acts as an R&D service provider to the company's business units, focusing on longer-term and higher-risk research projects likely to have market impact in five to 10 years. At the corporate level, it helps top management understand new technologies and their market potential. GE Global Research, Europe, has a strong partnership with the Technical University of Munich.

## LESSONS

***1. Corporate research labs are a good bridge to industry***. "Corporate research centres like ours are much better at bridging to the academic world," says Härtel. "We are the ones who come closest to the academic mindset… Our job is to demonstrate feasibility of advanced technologies, be it in manufacturing of composites, image processing, turbine aerodynamics or any other field relevant to GE. And by staying in touch with universities, we ensure we've got the line of sight to the latest scientific discoveries."

***2. Build trust.*** Härtel takes time to get to know university researchers and work with them on smaller projects before engaging in large-scale collaborations. GE Global Research is funded by its internal business customers, so partnerships with universities have to be paid by regular project budgets. "Before our business unit customers trust us to collaborate on their work with a partner university, we have to build credibility. GE Global Research and TU Munich built that trust by doing smaller programmes and showing they could deliver results together." Starter projects might include sharing a lab or equipment, thesis projects for students or tying in experienced university experts as consultants.

***3. Choose the right people, define an objective.*** Many partnerships falter due to poor leadership. "I'm always skeptical – companies often seem to send money to universities or government labs hoping that research done by smart people is automatically going to produce something of use… It takes spotting the right people – that is key – you have to have people who have the right attitude and share the same objective. Even if it's more open-ended research, the partnership should start from clearly agreed deliverables. You need to define together what success means, and how you will go about achieving it. Partnerships can't be based on an idea that just sounds interesting. That is recipe for failure. If both parties agree on specific objectives and speak the same language, I bet the collaboration is going to be successful."

***4. It's about collaboration rather than sponsorship.*** That means people have to get along very well – and spend time together. Proximity matters a great deal in R&D and innovation. "I do not recommend partnerships with universities where people are hundreds or thousands of miles away," says Härtel. "The close way we interact with TU Munich would not be possible with universities in Hamburg, Berlin or other remote places because we can't just walk over for an afternoon to sit and discuss results. You have to spend a significant amount of time together to make it work well."

***5. Promote cross-disciplinary work.*** Members of GE Global Research projects

are evaluated on the success of an overall project – not only on their individual contribution. If team members don't deliver together what they committed, "no one gets rewarded, so they have an incentive to collaborate across disciplines. That's very different than university culture. Incentive schemes in university research are not conducive to collaboration. That's why academics often live in departmental silos and rarely talk to each other."

***6. Don't let IP be a stumbling block.*** "IP is important, no doubt. But its role shouldn't be overemphasised in industry-university relations, says *Härtel*. "Companies can be overly concerned they will lose control over critical know-how; and some universities seem to have unrealistic expectations as to how much licensing income can be generated from patents. We do have patents that came out of our university programs, but the true value of collaborative R&D is in accessing and leveraging tacit knowledge. "Some of the best known universities have such restrictive IP terms that we simply cannot work with them. If IP protection goes to the extreme on either side, trust and a productive relationship are hard to build. A few years back, European industrial R&D association EIRMA published guidelines for responsible partnering between companies and academia. It's a great baseline from which to start discussions.

**CASE 13**

## SIEMENS-TU BERLIN, MIT

*Key interview: Reinhold E. Achatz, former head of Siemens AG Corporate Research and Technologies (2006-2012), former member of the Siemens Innovation Steering Committee, member of the European Area Research Board. (Achatz moved on 1 April 2012 to ThyssenKrupp as head of Corporate Center Technology, Innovation & Quality)*

Like many technology multinationals, Siemens has shifted to long-term strategic partnerships with a handful of universities to foster an intensive transfer of knowledge. The move is away from "a large number of not very structured relationships," Achatz said. Siemens chooses its key university partners based on topics of strategic value to the company. It currently has eight such partnerships – four in Europe, two in China and two in the US. The company seeks universities with an "open culture." With the Technical University of Berlin, the company works on innovations related to energy-efficient cities. At MIT, the partnering focuses on health care and medical technologies, and at the Technical University of Munich, the focus is electric mobility and optimising ICT embedded systems.

The results of partnering range from the creation of basic knowledge that will feed into the development of future products, to innovations in existing products, highlighting the evolution towards open innovation. As part of a Siemens-MIT collaboration in the area of brain research, for example, Siemens provides MIT with the prototype of the latest magnetic resonance imaging technology to use in research, which then helps MIT researchers advance the base of knowledge about brain function. "We don't see this as product development, we see it as partnering in basic research or in some cases applied research," says Achatz. Ultimately, the work leads to an improvement in devices and a better understanding of the human body.

"It's a lot of knowhow and knowledge and eventually a number of publications which create tangible value."

Achatz notes that university collaboration is vital to companies working on technologies that are part of a paradigm shift. Company research departments may have a harder time driving innovation in new technologies if they must displace existing ones that are successfully established in the market. In universities, we find that people are more open," says Achatz. Together with the TU Munich, for example, Siemens began two years ago working to develop a new architecture for electric cars that is simpler and cheaper than that of today's electric cars. "In the future, everything can be made simpler with a new structure," says Achatz, adding the likely market arrival of such a vehicle is still 10 years away.

## LESSONS

**1. Identify a win-win situation.** Start by understanding the objectives of the university and the needs of the company. This works with US, Asian and European universities.

**2. Establish strong structures to cooperate with universities.** The right structures help nurture successful partnerships. For its strategic partnerships with academia, Siemens places a Center of Knowledge Interchange (CKI) as a single point of contact on each campus to manage the projects and the relationship with researchers. "It's a person or a small group of people that create the link between the university and the company. Both universities and companies are complex systems. You need someone who understands both."

**3. Make sure university technology transfer organizations don't hinder strategic partnerships with industry.** The most difficult thing about partnering often is the start, including negotiations with the legal and technology transfer organization. "They have their own special focus and are less flexible," says Achatz. "They want to market their own ideas and sometimes that does not allow a win-win partnership structure." Use framework agreement for IP to avert the need for ongoing contract negotiations. Addendums can adapt the agreement to special circumstances.
Universities should not overestimate the opportunity of making money from patents. This happens once in the lifetime of big organizations and is hard to predict. IP is a critical topic, but it's totally overestimated by universities. It's less important for universities than for companies. We use it to protect our products and solutions.

**4. Collaboration on teaching soft skills can accelerate innovation.** We do not have enough managers who understand both IT and the business aspects of international collaboration. We are now training PhD students in soft managerial skills, working in a global organisation, teamwork skills and entrepreneurial skills.

CASE 14

# NOKIA-AALTO UNIVERSITY, UC BERKELEY

*Key interview: Hannu Kauppinen, acting head, Nokia Research Center*

University collaboration is vital to Nokia's research efforts and competitiveness, particularly as it seeks to transform itself from a product company to one focused increasingly on services. The company's current focus is strategic collaborations in energy efficiency, communications technology and location-based services. They are exploring technologies that may impact the market in three to five years.

Nokia has a long-running collaboration with Aalto University in wireless technologies and multimedia technology research. The company has two teams working in university labs, and Aalto researchers also work at Nokia's Research Center. "Aalto has over the years developed world-class competence building wireless systems from components to managing the networks themselves," says Kauppinen. "It's been a very tight relationship resulting in a high number of patents, publications and people flowing to Nokia."

Finland's national technology funding programme, administered by an organisation called Tekes, helped enable the partnership. It allows companies to apply for research funds that are channeled to universities and SMEs. "It's a tight and fruitful collaboration. Aalto has excellent competence and high-quality research," says Kauppinen. Work focused on new systems or standards that will hit the market a few years from now complements Nokia's in-house R&D. "It's typically on the leading edge and would be too risky for us to pursue. It can include new, disruptive business ideas."

## RESULTS

Nokia partnered with UC Berkeley's department of traffic engineering in research focused on enabling improved traffic circulation. The project, called "Traffic Works," collected the data of people driving with GPS systems to access traffic patterns and predict traffic jams in real time. The GPS data is much more accurate than sensors, which have been used up to now, says Kauppinen. Nokia used the research to launch a traffic data service offering to mobile phone users.

## LESSONS

***1. Company and university leaders must understand each other.*** Partnerships start with people. Universities have to listen to companies because they are the customer and they are spending either a lot of money or time on the collaboration. The trick to getting this right is to have the right kind of people on both sides.
Partnerships that have not worked well for Nokia are those where it "poured a lot of money in the form of a grant or direct funding and the university did not listen to us. The results were not meaningful for the company and we have stopped that kind of work," says Kauppinen.

***2. Cross-disciplinary research capacity is key.*** UC Berkeley is a very good example of a university where people mix across

different disciplines of technology and science – from engineering and physics to computer science and business. The model comes from North America's top schools. The University of Cambridge and the Swiss Federal Institute of Technology in Lausanne are also good examples of universities with a strong cross-disciplinary approach.

***3. Make sure IPR is not a stumbling block.***
***"***Wherever we fund research, we have to make sure IPR is not a big obstacle to the collaboration," says Kauppinen. "We pay for the competence-building and being part of the network."

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# RECOMMENDATIONS

**Innovation does not happen in a vacuum: A context – the economy, society and policy – shape how easy or hard it is innovate. Policymakers set that context. Throughout our interviews, the role of government was 'the elephant in the room'. No professional R&D manager, on either side of the university/ industry divide, were in any doubt that politicians are important. And while their opinions differed on some points, on at least a few key issues a clear message emerged.**

## 1. KEEP THE SHIP STEADY

Long-term, strategic partnerships of the kind illustrated in this report require correspondingly long-term, strategic policy. An on-again, off-again, crisis-driven approach to economics or regulation merely rewards short-term tactics, from companies or universities.

This is especially so with budgets: Examples are rife of sharp run-ups or run-downs in public research funding that cause turmoil and some damage to a country's science and technology base. A prime example is the famous "NIH Cliff", when a near-doubling in US government funding for the National Institutes of Health during the late 1990s and early 2000s induced many universities and companies to expand their biomedical research – and then even more rapidly, as budget austerity bit, to stamp on the brakes. Many new labs were shuttered, and young research careers were derailed – and that was the consequence merely of a few years of unexpectedly flat federal budgets, rather than any deep cut. In Europe, similar funding uncertainties have slowed the progress of alternative energy research – promised in the EU's Strategic Energy Technologies Plan, but not delivered by the member states in their annual budgets.

But the need for stability goes beyond budgets. By definition, the potential impact of new technologies is unpredictable; there's a natural human tendency to over- or under-react. But frequent changes in the regulatory environment for such nascent fields as nanotechnology, genetic engineering or "unconventional" gas technologies discourage industry from investing, and starve the very research partnerships that could answer the regulators' questions.

## 2. GIVE UNIVERSITIES AUTONOMY TO FORM PARTNERSHIPS

The Innovation Board has stated this before, and repeats it here: The best people to

decide a university's strategy are those directly responsible for its success - its board and its faculty heads. In an educational marketplace, each actor must have a certain freedom of action to react quickly to demand, problems and opportunities. They cannot forever be second-guessed by an education ministry, or have their budgets set – down to the line item – by a research or defence ministry. The best European universities already operate with a fair degree of autonomy from political control. More should do so.

Several corollaries follow from this – and they should be encouraged, or at least not discouraged, in national law. University boards should be diverse, open and have real governance powers – including over budget. They should be free to set the university's strategy, and set employment and admission policies. And they must be held accountable for their decisions. They should, in consultation with stakeholders in government, industry, the local community, staff and students, specify a set of performance metrics by which they will be judged. And if they are failing, it must be easy to replace them. Whatever the mechanism in local law or custom, it should be possible for a sizeable plurality of dissatisfied stakeholders to sack the board expeditiously.

## 3. REWARD COLLABORATIVE UNIVERSITIES – AND ENCOURAGE MORE

Carrots and sticks are the language of incentives everywhere – including for university administrators and corporate executives. If strategic partnerships are good, then government should reward those universities and companies that pursue them successfully. For the universities, this can be a bonus in public funding – such as the British government, with its innovation incentive programme, provides; or as the German government, with its Excellence Initiative, has permitted. For companies, it can be a specific tax incentive for collaboration.

But equally important is to get more universities and companies to try their hand at partnership. The record of university-industry collaboration is spotty across Europe – with a long and deep history of it in the UK, Scandinavia, the Netherlands and Germany, and a comparative rarity in Portugal, Greece, the Czech Republic, Hungary and other EU states. We applaud the Commission's effort to establish its Knowledge Alliance programme to encourage more experiments in university-industry relations. And while the jury is still out on so new a programme, we are encouraged by the speed with which the European Institute of Innovation and Technology was able to get its first collaborative "innovation factories" established and operating across the Knowledge Triangle.

## 4. HELP UNIVERSITIES STRIVE FOR EXCELLENCE

Companies want to work with the best – always. They cannot afford to do otherwise. That means that all EU and member-state efforts to encourage the best in research are to be applauded, especially if they selectively funnel money to the best. As this research indicates, the most successful technology multinationals have deep partnerships with a

relatively small number of universities; they do not scatter their money across the globe, in hopes of stumbling into a breakthrough. As a result, if Europe wishes to compete in the global marketplace for science and technology, it must strengthen a small number of top-class universities.

This may sound undemocratic, unfair or politically unrealistic. In every country, there is a natural budget conflict between feeding the best and feeding everyone. Nothing in this report suggests that government support should be denied the less-developed regions or universities; a broad base of technical training and varied research is a prerequisite for a 21st-century economy. But this worthy assistance should not come at the expense of Europe's true towers of excellence. A Cambridge, Karolinska, ETH, Heidelberg or Paris-VI are priceless jewels in the Europe's crown, and need continued support. Likewise, the best individual researchers – such as those supported by the European Research Council regardless of what institution they come from – require sustenance. We note that the Commission says, in its Horizon 2020 programme, that excellence shall be the "sole criterion" for research grants. That's great. But as so often happens in politics, we also note a range of additional programmes proposed to support a wider spread of funding across the EU. Inevitably, in a time of economic difficulty, a choice will have to be made – and we urge the Commission and the Parliament to recall the primary importance of excellence, when budgetary push comes to shove.

A clear result of this research is that, for sustained success in innovation, deep, long-term, strategic partnerships are essential between industry and academia. The role of government is to facilitate this natural tendency.

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