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Chapter 1: Firms engage with universities in many different ways

In the so-called "knowledge economy", two actors, the enterprises and the universities seem to be destined to work more and more closely. These constitute actors of the Distributed Innovation system, described in a previous book, *Resolving the Innovation Paradox*, by one of the authors. In this novel approach, the innovative company federates various elements from external actors, integrating them with the internal capabilities, in order to develop market-oriented, "high impact offerings" in an entrepreneurial perspective. In this way, on occasion, the company orchestrates multi-actor innovation projects without being constrained by its own internal capabilities (1).

Most countries are engaged in sustained attempts at formulating and implementing policies which aim at reinforcing theses linkages, sometimes called with the not very helpful term of "crowdsourcing". This denotes an effort to federate many individual and institutional inputs.
Among these many interactions, the specific and important area of transferring novel knowledge and technology from universities to firms constitutes the subject of this book. This transfer is not a straightforward affair. In going from science to business, the path is full of pitfalls. This path involves two very different partners, which have different missions and histories. After a brief introduction on each of these two actors, the different ways of partnering will be reviewed, thus outlining the structure of the book, which concentrates on the three main vehicles for such technology transfer: collaborative research, licensing and spin out ventures.

Universities and firms, two key actors of the so-called "knowledge economy"

Universities and firms belong to different worlds. We take a rapid look at some historical aspects of these two actors to underscore their differences in perpspective

Universities

The institutions of universities have gone through many centuries. In China, Nanjing University, founded in 258, was, with more than 10 000 students, the world's largest institution for higher education in the XVth century. In Europe, Universities appeared in 1088 in Bologna, and about 1150 in Paris (La Sorbonne) and Oxford. In Bologna, groups of students grouped themselves and contracted with Professors, obtaining the licence to teach *licencia docendi.* This "bottom up" process was thus regulated by the state after the fact.
Europe's Universities were heirs of the Greek Academies and were a secular response to the scholarly traditions of monasteries. Later, many University campuses

indeed incorporated the reflective quadrangles of meditation-prone cloisters, which were themselves derived from Greek and Roman architecture.
In the late XVIIIth century, Alexander von Humboldt defined the role of the university as providing a formation ("Bildung") to the individual, stating that, contrary to high school, in higher education, "both the teacher en the student are partners in scholarship".

Like artists, scientists have long entertained relationships with the leaders of their time, as precursors of technology transfer, while military preoccupations were often the rationale at work. When Archimedes, born in 287 BC and lived 75 years in Syracuse, was asked by the king Hiero II to detect whether his crown was pure gold, the mathematician and inventor came up with his law on buoyancy. At the time, he was employed as a tutor for the son of the king.

Firms

Corporations are much younger than universities. Roughly, they appeared in the XVIIth Century in Japan (Sumitomo, to exploit copper mines) and France, with Saint Gobain (to produce flat glass and mirrors for the Versailles Palace). Below is a century quote on the duties of the plant manager, from the 'Rules for the Royal Manufacture of Saint Gobain':

'*He shall devote all his ability and application to manufacture good glazing and avoid defects which are but too frequent. He shall listen to all ideas on that matter whoever they are coming from. He shall make mature reflections and take the benefit of it, if he finds them good. He shall beware of falling into the mistake of some of his predecessors who, by fantasy and presumption, imagined that all which did not come from them could not be good*.'

This text, dated 10 December, 1728, is remarkable in that, almost three centuries ago, its statement singles out the key concerns of today's management, such as quality and low reject rate, the NIH – Not Invented Here syndrome, the necessity to have an open mind and the willingness to listen to suggestions.

One of the pioneering books on management was written by the French Henri Fayol (1845-1925). In his book "Administration Industrielle Génerale", published in 1916, Fayol, long time Director of the Commentry Coal mine, sees six parts in the firm: Technical, Commanding, Finances, Safety, Accounting and Administration". The role of the manager is to: anticipate, organise, command, coordinate and control.
Military metaphors are frequent in this book, which was later shaped to suit the mass manufacturing firm (Sloan). The recent managerial gobbledygook distances itself somewhat from the military verbiage to use biological metaphors instead: we hear *ad nauseam* phrases, such as: "the DNA of a corporation".

Contemporary issues of firms are more about dealing with the breakneck rate of change to remain competitive. As for tomorrow, the common wisdom is that it will continue to be a "hyper-competitive" business world, in which "the only sure thing in the future is *change*". With the world facing a multiplicity of crises: climate, energy, food and water – which constitute opportunities for entrepreneurs and corporations,

change is certainly the operating word for the coming decade(s). This is to be added to the fast moving, turn around world, where world-wide competitors and the use of information technology continue to brutally disrupt the competitive scene and the ways to do business.

Broadly, firms may be subdivided into three categories: Corporations, SMEs-Small and Medium size Enterprises- below 250 employees, and start up companies. In an economy, they interact and trade with each other, as part of what is often called an "ecosystem", to produce goods and services. For example, Corporations are usually clients of start ups in business-to-business transactions. It is therefore desirable that the large companies are not too conservative and are amenable to try the new offerings of young or much smaller companies.

Connecting the two worlds of firms and universities became even more necessary when different disciplines of science & technology developed their substantial body of knowledge. In the XIXth century, a specific point of contact emerged with the R&D department. "Invented" in Germany for improving processes in the chemical industry, the R&D department was staffed with university graduates. For the first time, a systematic process was at work to transfer technology from universities to firms.

Key is not how much firms invest in R&D but how they perform it

One difficult issue with R&D investments is that it is extremely difficult to assess their impact. R&D is only one element of the innovation process, which indeed involves practically the whole firm. Also, what counts is the output-success in the market place – rather than inputs – the R&D budget. A Study by Booz Allen Hamilton Global Innovation report (2005) confirms that lavish R&D budgets indeed do not guarantee good performance, measured by commercial success, profitability and market share. It is more critical to leverage astutely the various external sources which can fuel the firm's innovation process, as proposed by the complementary approaches of open and distributed innovation. Among these external sources, universities and public research laboratories (PROs) seem to be partners of choice for industry.

Firms acquire a competitive advantage through such partnerships. Among the reasons cited by firms, the Lambert Review (2) lists the main benefits for firms to work with universities:

- Access to new ideas, breakthroughs
- Access a large intellectual pool of competencies or technologies
- Leveraging the research dollars with public funding scheme
- Spot and recruit brightest young talents
- Expand pre-competitive research
- Access to specialized consultancy

The same study points to a good correlation between business success & economic performance and University collaboration (reference 2, page 24).

From the OECD Science, Technology and Industry Outlook 2008, it is noted that, as a percent of GDP, tertiary education institutions performs a small 0,25 % of the R&D carried out in the OECD country. This level has been fairly stable in over the last ten years. The percentage is 0 .4% for public research organisations. In absolute terms, however, investing on R&D in the higher education sector has experienced a fairly strong growth in recent years, especially in China and Ireland (13% between 2001 and 2006). During that period, the corresponding annual growth in the OECD area has been 3,3%, as compared with 2,8% in the 27 countries of the European Union. This average growth rates point to a global increase of emphasis in partnering with universities and public laboratories.

The USA are often given as example as a country where take place the bulk of the world's innovation and growth in two crucial areas, ICTs and life sciences. In a recent book, the former CEO of Amgen, Gordon Binder, gives a perspective on this prowess (3). In his mind, the key is that it has the research capacity, helped by government funding and policy, and, more importantly, the enterprising spirit. This explains why the USA pretty much dominate in personal computers and software, semiconductors and biotech drugs.

Ways with which firms and universities engage with each other

There is a wide spectrum of ways with which these two "partners" interact directly or indirectly. They flow from the mission of universities, which is excellence in education and in research. These ways are listed below:

a) Education
- firms hire graduates from Universities. This is indeed a most powerful way to transfer knowledge and technology
- students carry out graduate work in connection with a firm
- students do internships in firms

b) Professional contacts
- informal contacts between employees of firms and personnel from Universities.
- Meetings on the occasion of Conferences or Forums
- Professors act as consultants or advisors to firms

c) Research
- contract and collaborative research, either on a one-to-one basis, or as a consortium of firms joining forces to solve a specific issue
- joint laboratories
- donations for long term relationships, such as endowments for research or Professorial Chairs

d) Vehicles for technology transfer of the outcome of university research
- selling licences based on patents owned by the university

- spinning out companies relying on knowledge and patents generated by the university

This wide array of interactions, according to which firms and Universities may collaborate and influence each other for positive change in creating new business activity is illustrated in Figure 1. They are organised by increased institutional character, in each of the four categories of interactions and will be discussed in the following sections.

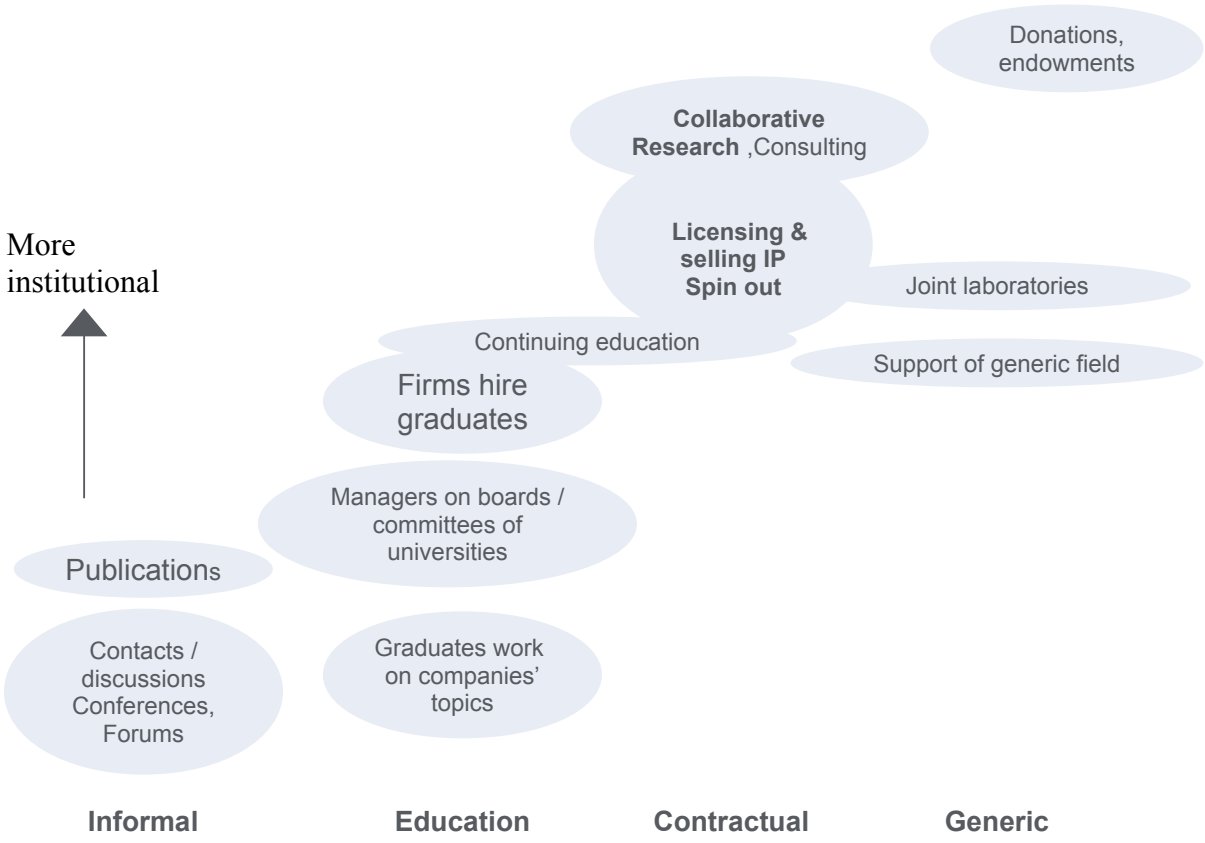

Figure 1: Ways in which firms engage with universities

The graduates are key agents for transferring knowledge & technology

A powerful link between institutions of higher education and firms is indeed constituted by the graduates working in companies. This makes it possible to maintain a flow of knowledge and technology moving from university to firm. As an example, Kamil Quadir, following his graduation form an American university, founded the company CellBazaar, to make cell phones available to the population of Bangladesh, where he grew up. In a country where the lack of electricity makes it

impossible to have access to internet, millions of individuals are users of CellBazaar for connecting, trading and entertainment.

These alumni constitute a more or less strong “lobby” to influence the university. They may play a role in this, particularly in the USA, but also in the so-called French “Grandes Ecoles”, institutions of higher education, which recruit on the basis of competitive exams, two years after the end of high school. In such Institutions, the alumni associations generally have a powerful voice. They may also provide useful networks, helping to develop businesses or finding the next job. This said, beyond general statements such as “we need more computer scientists” or “we want adaptable, problem-solvers, effective team players”, managers of firms generally cannot, or do not want to, define the specifics of university curricula.

Updating university curricula is relatively straightforward within each scientific discipline. There will presumably be an agreement on having more and more genetic engineering in life-sciences studies, for example. What is more difficult is to deal with the balance of disciplines within an academic curriculum: how much mathematics should be taught in a four-year Science Bachelor degree, or how much of an introduction to management should engineers receive at the undergraduate level? Not to say anything about an effective education in languages, “other” cultures, or history and philosophy.…

For universities, a difficult adaptation is in the pedagogy. If a medical school wants to introduce the case study method, pioneered by Law schools and later used extensively in Business Schools, a broad agreement has to be found across the various fiefdoms constituted by the medical departments,….and additional resources must be found to provide a more hands on education. A similar issue concerns the use of distant learning. Pioneered in Great Britain, a new Institution, the Open University, had to be created, in 1969, in order to be able to fully predicate its education on electronic media – television at the time.
Universities have the “academic” tradition of individual Faculty members pursuing their own specific topics. A true cross-disciplinary approach, which is required to address real life issues, encounters multiple obstacles in such an environment. Again, because of this fiercely individual orientation – some people would talk about the silo mentality – universities do not do a good job of “knowledge management”.

A broader debate is whether research constitutes a natural companion activity nourishing the educational mission of Universities. The so-called “leading institutions” all have strong research activities and, for them, their clear mission is indeed excellence in teaching and excellence in research. Some outstanding learning takes place in Institutions where the Faculty do not carry out research activities, however; for example, a number of small, private Universities, or State Colleges in the USA. In science & technology fields, how truly pertinent is the slogan “education through research”?

How do Universities anticipate the “needs” of society, so that they best equip their students for the future, is a vast topic, largely influenced by the governance of the Universities, as well as the culture and traditions of the country where they operate. Let us only remark that, all over our interdependent world, countries are generally

dissatisfied with their own educational system and are trying reforms and adaptations of an institution, which has inherited from centuries of tradition.

Universities must indeed work with pupils coming out of high schools. Countries should be much more attentive in making sure that secondary education offers a solid foundation, at a time when there is, in most parts of the world, of weakening of the general level of pupils is observed. According to OECD rankings, Finland comes out as providing the best scientific (particularly in mathematics) education. Without arguing how valid are such rankings, PISA or otherwise, it does seem that, by and large, a great strength of Europe, as well as that of Asian countries, is precisely that it provides a generally decent level secondary education, a basis for apprehending the world and a foundation on which to build. In Europe, the first recognition of this mission was by Calvin, which created the first secular mandatory secondary school in 1549, in Geneva.

An excessively "utilitarian" approach of secondary education is counterproductive. In "western" countries, learning "dead languages", such as Latin and ancient Greek go well beyond learning about language roots, but provide the ability to learn how to learn and to have different "points of view" on the universe, which is crucial to detect patterns with an open mind, in our interdependent and fast-changing world. In a similar vein, the recent "utilitarian" decision of China to impose English as a language in high school seems to make sense, but should not dry up the richness of diversity of the Chinese world. There is hope, as India does not seem to have lost too much of its extraordinary cultural diversity for having practiced its own brand of British English for many years….

Conversely, people of English mother tongue feel that, having the world language - until Mandarin takes over, they do not need to learn another tongue. As a result, they are severely handicapped in their inability to adopt another point of view, which another language richly provides. In the days when Greek was the "world language", Herodotus was violently critical of the ethnocentric attitudes of his fellow Greeks towards the barbarians - the non-Greeks…

University-industry consortiums for graduate/continuing education

Knowledge transfer may be achieved by having industry and university working together to launch a new course. This may be a technical course for continuing education in microelectronics or security of Information technology systems, for example.

This can also be achieved at the level of a graduate course. One example is the Master of pharmaceutical medicine for effective drug development, launched late 2009 under the innovative medicines initiative IMI. The initiative is funded (15 million euros for 5 years) by the European Union and the industry on a 50/50 basis. The consortium is constituted by 6 universities and 15 companies.
The aim is to provide a comprehensive course providing a fully integrated understanding of the complete drug development process, from molecule discovery to market introduction. It is a response to the fact that pharmaceutical companies world-wide have insufficient drug development pipelines. In recent years, the

European Medicine Agency EMEA has approved only 20 new drug applications per year. This university-industry initiative aims at making the pharmaceutical innovation process more effective.

Broad linkage between business and Universities

At the institutional level, universities have been under increasing pressure to establish connections with the key actor in our economy: companies, small or large. It can be argued that the venerable universities of Cambridge and Oxford did not create a business school to further enhance their academic credibility, but to establish a bridge with the business world. To do so, individuals gave each university a large donation to start the Judge Institute at Cambridge and the Said business school at Oxford. This is a repeat of Alfred Sloan, long time President of the now infamous General Motors Company, asking MIT to start a business school in 1952.

Beyond the fact that it makes eminent sense to diligently maintain a rich dialogue with their alumni now employed by firms, universities can secure helpful intelligence on the evolving needs of the enterprises by keeping in contact with the workforce. Universities are increasingly realising that their alumni represent one of their crucial assets, but few of them dedicate adequate resources, in persons and money, to make an effective job of it.

In 2008, the University of Tokyo launched a new high level education programme for senior executives, most of them alumni, thus reinforcing their connection with the *alma mater.* The alumni population of the school represents a privileged access to firms and is indeed a great source of professional contacts discussed below.

Professional contacts

Through informal contacts between Faculty, students or alumni and employees of companies, universities have a position of influence. These contacts are channelled through specific meetings, at Conferences and trade shows, Few companies pro actively seek out such inputs: by and large, such conversations are opportunistic.
This is not to say that they are not influential. Managers indicate that insights and new ideas (often about a third of the ideas) germinate in the course of conversations with “academics”. Others confirm that, among their key sources of intelligence on technology and markets, a number of selected Professors are regularly consulted. One way to make this happen is to participate in conferences and meetings. Another way is to tap into “expert groups” via internet. The value of these is uneven, may be because electronic networking is still a recent practice. Occasionally, such informal “electronic” contacts may lead to a more formal connection covered by a consultancy agreement.

Consultancy agreements occasionally bind an individual Professor with a firm. Universities have rules on the terms of the contract, as well as on how much days of consultancy are allowed per year. Increasingly, the university takes an overhead percentage (10 to 15%) on the consultancy fees, since, after all, Professors obtain consultant jobs largely as a result of their affiliation with the institution. Other

universities, Imperial College in London for example, channel the consultancy activity of their Faculty through a consultancy subsidiary. Other times, consultancy services are lumped together with the technology transfer services, providing collaborative laboratory-based research projects.

The main vehicles for universities to transfer their knowledge and technology to firms constitute the object of this book, as described below. As an introduction to presenting the structure of the book, the book *The triumph of Technology* (4) stresses that the principal challenge for any research organisation is to be effective in technology transfer. This is particularly the case of universities.

Focus of this book: Collaborative research, licensing and spinning out start ups

The present book focuses on the vehicles for transferring university's knowledge and research results into firms and new businesses. These are: collaborative research, licensing and selling IP (Intellectual Property) and creating spin out companies based on university research. These are discussed in turn in the three following chapters.

Chapter 2 describes collaborative research, by which the firm taps into the technical expertise of an external partner – the university or a public laboratory, in this case. It covers a range of possibilities, in terms of the scope of the project – exploring an area or carrying out a focused project – and in terms of the duration – short and highly specific or long term collaboration of a more generic nature. In all cases, the collaboration must follow a period of discussion and negociation, allowing the parties to align their objectives.

Chapter 3 discusses another route for transferring technology from university R&D to a firm: it involves selling a license based on a university patent, or selling its intellectual property (IP) outright. Indeed, similar licensing transactions take place between a firm and another firm. Licensing requires specific areas of expertise. By exploiting the patent, the firm improves its business position or builds new activities.

Chapter 4 concentrates on the most complex way of transferring university Research & Development (R&D) into a commercial venture. It involves creating a firm, a *spin off* or *spin out* start up company - based on the technology-intensive business idea generated by the university. This process requires considerable know how, in order to bridge the gap separating the novel technical idea from its successful commercial deployment in the market. The start up may either grow on its own, or be purchased by a corporation, to reinforce its activities. The latter is particularly practiced by the pharmaceutical/biotech sector.

Chapter 5 looks into the particular situation of Small and Medium-size enterprises (SMEs), as they tap into the knowledge base of universities and public research laboratories. By partnering with external actors, they enhance their innovation-led growth, but encounters specific issues, as the capacities in manpower and finances

available in SMEs are more constrained than is the case for corporations. As a result, specific mechanisms must be put in place.

Chapter 6 looks at some specific, critical framework conditions allowing firms to successfully engage with universities, in order to contribute to their business creation process. A comparison between the USA with Europe show many parallels, whereas Asia is rapidly moving forward. At the country level, the example of Switzerland is described, as it is recognised as handling knowledge & technology most effectively.

Chapter 7 outlines the way forward in the academia-firms partnerships. It points to trends which will impact such partnerships and emerging models of firm-university interactions for generating new business. It details the changes, which both the universities and companies are expected to undergo in the future. On occasion, implications for public policy are underscored.

In the course of the following Chapters, two topics are woven into the arguments: sustainable development and Asia. These are discussed below.

Two themes run through this book

Two themes run throughout the following chapters. We believe that they will strongly impact partnerships between firms and universities & public research laboratories, aimed at enhancing activities or creating a new businesses. First, the world needs to go through a metamorphosis, in order to become more sustainable. Second, in Asia, in addition to the technological powerhouse of Japan, two countries, China and India, are rapidly evolving and will profoundly affect the world's geography of innovation. These themes are briefly discussed below.

Towards a more sustainable system

In addition to the crisis of a system, triggered by the financial debacle of the Wall Street "subprime" loans, our world faces a multiplicity of long-term crises: climate change, energy, food, water, raw materials, demographics. These bring opportunities, but also tremendous challenges, whose responses must fully involve firms effectively partnering with universities.

We urgently need positive change towards a more sustainable system. This involves new sources and better management of energy, more responsible operations of the firms, but also, inspiring responsible behaviour on the part of customers. The latter often underestimate the power they have to effect positive change in the world. The need is for a massive amount of innovation for transforming our system, while individuals will have to change their lifestyles considerably.

In this transformational process, universities must play their full role, by teaming up with private firms and public institutions. This may be a key element of the constant effort of universities to be ever more "relevant" to society.

The logic is at work in industrialized countries. Academics eagerly cluster around money without, hopefully losing their soul in the process. Partly as a result of the need to understand better the business world and, possibly, to adopt some of its management practices, senior managers from industrial companies or consultant firms are increasingly selected to become Presidents or Rectors of Universities. Such "grafts", however, have been often rejected by academic bodies.
This attempt to "relevance" concerns the education of students, as well as the Research & Development (R&D) activities. Although many examples in this book are in the field of Science and Technology, universities have a lot to offer to firms in non-technical fields, such as social sciences and conceptual innovation.

Asia: fast growing source of innovations for the world

For the first time in human history, very large dynamic economies are fast appearing as main actors in on the world stage: China, India and Brazil,…
As a country, to which apply so many superlatives, China is rapidly becoming a world actor in yet another area: *innovation*, in the technical arena, as well as in the business and management sphere. The speed and robustness with which these evolutions take place are the object of some debate, but it is difficult to overestimate the importance of the *China phenomenon* for the "western" economies and firms. In a recent speech, the President of Yale concluded on universities (5) by expressing that the rise of Asia's universities is a manifestation of globalization. Nations of Asia have increasing access to the resources needed to create institutions of excellence. In conclusion, he salutes this as a very positive trend for the world.

The tremendous dynamism of China's markets

Today's China represents 8% of the world output, as compared with 1% thirty years ago. But it may be more appropriate to speak about the re-emergence of China, since in the XVIII th century, it is estimated that China accounted for close to 20% of the world output.

The sheer size and the growth rate of China, unprecedented in history, result in this: what China sells, such as toys or consumer electronics goods, depresses world prices, while what China buys increases world prices, namely oil and commodities. On the educational side, every year, close to the population of Paris walks out of Chinese Universities with a Bachelor degree.

In the stores of Chinese cities, consumer goods are being replaced at an amazing speed. Products, packaging, marketing and branding, are the object of extremely rapid changes, in order to satisfy discriminating and fast changing consumers' demands.

In the 1980s, Japan was the benchmark of a market characterized with short "shelf-time" of products and utmost quality. For this reason, non-Japanese companies saw that country as a demanding testing ground, where much could be learned, so as to become more competitive in the world's market. In many ways, China is currently a

test-country in its own right, but this phenomenon is amplified and accelerated by the sheer size, the fast growth and the entrepreneurial spirit of the country.
Observers from outside China are somewhat mesmerized by the unusual combination of a very strong command regime and a great "plasticity", which makes it possible to accept a high rate of change.

Innovation goes East

China's relentless efforts in Research & Development (R&D) investments are reflected in the (very crude) indicator of patent filings. In 2007, this number increased by 38% over the previous year. China now ranks seven in the world. This is an indicator of China's fast increasing its investments in R&D. These now represent 1,5 % of GDP, not too far from the 2,3 % average figure of the 17 current member states of the European Union. The target is 2,5 % of GDP in 2020. Again, these are inputs figures; they are far from telling the whole story. The country's effort, however, is very substantial and, by design, most Chinese top government officials have an advanced scientific degree, so that they well understand the power of technical innovation for job- and wealth- creation.

In our interdependent world, technology firms must widen their array of innovation & development units. The main reasons to start a new "offshore" R&D unit or to tap into Chinese Universities' expertise are 1) large and dynamic market and 2) access to local talent. Lower cost is a secondary, but welcome added benefit. On the basis of these criteria, China is clearly a location of choice. However, a requirement in this area is an infrastructure of quality and reliable enforcement of the protection of intellectual property (IP), singularly patents and court litigations on IP.
This is particularly important for pharmaceutical companies, for which a strong patent infrastructure is an absolute requirement for business. Crucial to the future of China as an "innovation-land" is the way in which the provincial courts actually put the WTO legal arsenal into practice, since the time China joined WTO in 2001. At the end of the day, China's domestic companies, either state-owned or private, are likely to constitute the key force towards making the IP scene a "level playing field", as the cliché goes.

China must thus be viewed as a rapidly developing into a "fountainhead for innovation". There are general areas for improvement, such as teamwork across functions and excessive "technology – push" type of innovations. Also, Chinese companies have not moved towards a more "open" or distributed" innovation system, relying on external inputs to a large degree. Several companies are already large global players: The better know are the computer-maker, Lenovo, the telecommunication company Huawei and the appliances manufacturer Haier. In addition, very large firms exist, like in the food sector, which are not known outside China.

"China as a nation of innovators ? It may not be too far off", concludes a 2009 Report "Unlocking Innovation in China" from the "Economist Intelligence Unit. China's contributions will indeed concern products and services, as well as management practices & values, and new business models. The key for firms is therefore to fully leverage the dynamic Chinese market, but also to participate in this vital innovation

scene, where China-grown innovations will increasingly flourish, for its domestic market, as well as for sale world-wide. From this, it follows that firms must carefully evaluate opportunities of partnering with China's Universities' research activities. The 211 Programme from the Chinese government aims at building institutions of first class quality. In addition, a programme started in 1999 to promote 38 universities to world class level.

In addition, the public research institutes of the Chinese Academy of Sciences have been reformed ten years ago. They total some 40 000 staff and are now divided into three types: 1) basic research, 2) market-oriented, for profit, contract research and 3) non-profit science & technology institutes providing professional expertise.

And India ?

When China is mentioned as an increasingly important source of new business models and technologies, the name of India is not too far. There are many differences between the models at work in the two countries. It is not the purpose of the section to discuss them in detail. Certainly, the political systems, the quality of infrastructure-better in China, the English language prevalent in India, are some of the factors for these differences. In both countries, there are very large numbers of engineers and scientists graduating every year and a lust for education.

In any case, numerous "Western" companies have R&D laboratories in India, of various sizes, and maintain collaborations with Universities in that country. By and large, these tend to be in the ICTs (Information and Communication technologies) and in the life sciences. As an example of the concern of policy-makers for the effective commercialisation of technology, the large Government Laboratories CSIR – Council for Scientific and Industrial Research, have created CSIR Tech, a separate holding to act as a conduit for technology transfer. The CSIR organisation was founded in 1942 and has 37 laboratory sites all over India, employing a total of 17 400 staff (12, 000 of them have a technical background). Its official mission is "to provide scientific and industrial R&D that maximises the economic, environmental and societal benefit fro the people of India".

When looking at the industrial activities in these fields, in IT services, the names of companies come to mind, such as Infosys and Wipro, both headquartered in Bangalore, and Dr. Reedy in the pharmaceutical sector. The values and the extremely rapid growth of Infosys are exemplary (6):

Infosys was founded in 1981 by seven computer engineers. Their vision for the company did not have much to do with revenues and profits, as they wanted to create the most respected company in India. For its customers, this company would deliver on promises and meet expectations. For its employees, it would create an open fair meritocracy. For investors, it would provide consistent financial performance.
Infosys got its first real break from the German technology company Bosch. The firm moved from Mumbai to Bangalore, in order to be close to this customer's data center. It subsequently carried out application maintenance and software development for

General Electric, Schlumberger, Siemens, Airbus and Crédit Suisse, delivering these services out of its offices in India.

In 1993, Infosys went public at the Indian stock exchange and shifted strategy to focus on selected vertical markets. The 1991 liberalization of the Indian economy, India's plentiful, low cost, skilled labor, and a time difference enabling round-the-clock operations for US/European companies, all this fuelled the growth of Infosys and India's emerging software industry.
Customer satisfaction is central in Infosys' breakneck rate of profitable growth. Over a 25-year-period, the company has successfully completed more than 20,000 projects with a rate of 99.998% error-free. Over 93% of these projects were delivered on time and on budget, far above the industry average of 30%. Such high customer satisfaction rate leads to over 95% of clients coming back to Infosys for further projects. Relying on such customer satisfaction, Infosys proactively seeks to expand the scope of the work it does with existing clients, further fueling the revenues' growth. Infosys fully understands that in the business of outsourced services, lower cost alone is not sufficient. Quality, reliability, speed and customer orientation are fully part of the equation.

Western businesses must be curious about innovations in China and India, in terms of technology, but also for new ways of doing business. The "West" must become much less ethnocentric and more humble, in order to *learn* from emerging countries ..

In the anticipation of the massive changes, that will result from the need of a more sustainable world and the rapid development of China and India, firms must learn from universities, among other external actors, how to anticipate, understand and leverage change.
As stated in a recent report (7), " *In a knowledge economy, universities are the most important mechanism we have for generating and preserving, disseminating and transforming knowledge into social and economic benefits*" . Given this, is seems sensible that firms should directly and proactively tap into university R&D

Never before, non-business issues have been so relevant to business. Never before have non-technical innovations been so critical to business success. These include novel business models or managerial practices, often enabled by ICTs-Information and Communication Technologies. Therefore, firms must occasionally escape the short term perspective and show imagination in projecting the broad-band range activity of university research into new job-creating activities. A key conduit between the two partners is the knowledge and technology transfer (KTT). The following chapters describe how this complex process may be best most effectively carried out, using the three main vehicles of collaborative research, licensing and spinning out start ups.

References

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