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**BEYOND TRADITIONAL TECHNOLOGY TRANSFER OF
FACULTY-GENERATED INVENTIONS:
BUILDING A BRIDGE TOWARDS R&D (**)**

ABSTRACT

Despite original differences between U.S. and European universities in technology transfer activities of faculty-generated inventions, European universities are becoming more and more aware of the importance of the intellectual property rights and their importance to turn research into direct economic impact. Traditional technology transfer is mainly based on licensing of inventions randomly generated. Such model produced a great deal of patents and immense patent portfolios, but a comparatively small number of licenses. This paper suggests a more cost-effective approach to technology transfer based on the idea of backward integration with R&D. Definition of market's needs in planning future research should be the key to have a more efficient ratio between patent issued and licenses executed. Being cooperation, at regional and international, a main factor of success for such a new methodology, some difficulties, biases and wrong beliefs can be encountered. They are also dealt with in the paper.

1. INTRODUCTION. SOME DIFFERENCES IN EU AND US ACADEMIA.

There still exist remarkable differences between Europe and United States in terms of university/industry relationships and technology transfer of university-based technologies. Reasons for such differences lie mainly in cultural and historical factors.

It is commonplace that a decisive, robust contribution to technology transfer in the U.S. came through the enactment by the Congress of the Patent and Trademark Law Amendments Act (most commonly referred to as the Bayh-Dole Act) in the '80s¹. About the fact that the Bayh-Dole Act played an important role for the growth of innovation there is general consensus; its effects will be shown in the furtherance of this article². On its quantitative impact, though, the debate is not yet settled³. Important studies have

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¹ Public Law No. 96-517 of December 12, 1980 (now codified under 35 U.S.C. 200-212).

² For empirical support see R. JENSEN, M. THURSBY, *Proofs and Prototypes for Sale: The Licensing of University Inventions*, in 91 AM. ECON. REV. 240 (2001).

³ See T. VALOIR, *Government Funded Inventions: The Bayh-Dole Act and the Hopkins v. CellPro March-In Rights Controversy*, in 8 TEX. INTELL. PROP. L.J. 211, 234 (2000).

demonstrated that the Bayh-Dole Act was not the only factor of development⁴; available data and evidence are controversial and what each university achieved depended largely also upon concurring environmental reasons⁵. Furthermore, some argue that the Bayh-Dole Act had a side effect in which it diverted the research agenda of academic institutions, making professors excessively keen on financial return and, because of this, more devoted to applied research⁶.

Transfer of technology hinges on a strong intellectual property protection. The European academia on its part has been traditionally skeptical, when not suspicious, towards patenting and, more generally, towards a private-like form of appropriation of publicly funded science's results. Despite the fact intellectual property protection is not at odds with scientific divulgation, the wrong perception of the contrary caused historically suspect around intellectual property rights within public research institutions⁷. Discussing the implication of different possible legal regimes for science is beyond the scope of this article; however, it needs to be highlighted that any technology transfer policy is inevitably influenced by biases and beliefs about the degree scientific advancements should be subject to a regime of property rights.

This article aims at comprehensively reviewing some features of traditional technology transfer of faculty-generated inventions drawing on the results of empirical studies done on this topic. Those results are then used to outline an alternative scheme of technology transfer, markedly market-oriented, with the purpose of providing European universities in the process of defining their internal innovation management strategies with suggestions and guidelines. These new schemes for transfer of technology can be considered as belonging to the new generation of technology transfer.

2. RECENT DEVELOPMENTS IN EU ACADEMIA ABOUT TECHNOLOGY TRANSFER.

Despite original differences between the two continents, technology transfer and related activities for faculty-generated inventions have gained momentum recently all over Europe. Universities and research centers show nowadays a deeper awareness about the importance of turning the results of their researches into more direct economic impact. Further reasons stand for such accrued interest. First and foremost, public funding for R&D is dramatically decreasing almost everywhere, because of financial difficulties experienced by local

⁴ D.C. MOWERY, R.R. NELSON, B.N. SAMPAT, A.A. ZIEDONIS, *The Growth of Patenting and Licensing by US Universities: An Assessment of the Effects of the Bayh-Dole Act of 1980*, in 30 RESEARCH POLICY 99, 100 (2001), hereinafter, MOWERY ET AL., 2001.

⁵ D. SIEGEL, D. WALDMAN, A.N. LINK, *Assessing the Impact of Organizational Practices on the Productivity of University Technology Transfer Offices: An Exploratory Study*, NBER Working Paper No. 7256, 1999, hereinafter, SIEGEL ET AL., 1999.

⁶ See authors quoted in J.J. THURSBY, M.C. THURSBY, *Who Is Selling the Irony Tower? Sources of Growth in University Licensing*, NBER Working Paper No. 7718, 2000, 3; hereinafter THURSBY ET AL., 2000.

⁷ See, in general, R.M. SHERWOOD, *Global Prospects for the Role of Intellectual Property in Technology Transfer*, in 42 IDEA 27 (2002) (asserting the essential role of intellectual property right for full-fledged technology transfer).

governments and because of the general shortfall of the E-economy⁸. In this vein, technology transfer is regarded as an additional source of financing for universities.

Second, as a consequence of the above-mentioned impoverishment of universities, the distance between applied science and basic science is doomed to increase and to conceal a more alarming dichotomy between rich sciences and poor sciences⁹. Revenues earned out of technology transfer activities can thus be used internally to cross-subsidize those disciplines that, by their very nature, do not spawn marketable results, nonetheless displaying generative virtues for applied studies.

Third, as a consequence of the creation of one, integrated market and an internal area of research, universities in Europe seem much more in competition today than they used to be in the past. They compete not only to attract perspective students, but also to lure the best faculties. In such a marketplace for human capital, ability shown by professors to engage in applied research activities, their enhanced attitude to intellectual property protection of their efforts, and their increasing propensity to get involved into commercial activities begin to be considered as important features for faculty's profiles and to come alongside the traditional credentials (overwhelmingly, publications) evaluated in the selection and hiring processes.

The institution of internal technology transfer offices (TTOs) and incubators by many European universities witnesses the current change. Of course, the pace towards a more pro-active approach in Europe is not homogeneous, as some campuses seem lagging behind; nonetheless, the trend appears continuous and steady.

Mapping out an innovation management policy within universities requires the solution to the usual alternative between 'make or buy', referred to technology management¹⁰. The schemes dealt with within this paper are compatible with any model adopted, although outsourcing the technology transfer function might determine higher coordination costs¹¹.

3. TRADITIONAL TECHNOLOGY TRANSFER AS A STARTING POINT FOR EUROPEAN UNIVERSITIES.

That a change in culture is taking off does not necessarily mean that European universities are uniformly equipped to undertake efficient technology transfer activities.

⁸ For the United States see T.A. MASSARO, *Innovation, Technology Transfer, and Patent Policy: The University Contribution*, 82 VA. L. REV. 1729, 1734 (1996).

⁹ The danger is noticed also by those authors claiming that a stronger involvement of universities into technology transfer could harm their mission. P.K. CHEW, *Faculty-Generated Inventions: Who Owns the Golden Egg?* 1992 WIS. L. REV. 259, 307 (1992): «[b]asic research is directed at answering an intellectual inquiry rather than achieving results with a practical application. It has produced revolutionary breakthroughs that have yielded highly significant societal benefits. Because basic research often lays the foundation for applied research, a decrease in the former could jeopardize the success of the latter» (hereinafter CHEW, 1992).

¹⁰ It is still a form of make when the university chooses to perform technology transfer through a controlled company, rather than through an internal administrative office. A very well known example is Isis Innovation Ltd., a wholly owned subsidiary of the University of Oxford.

¹¹ It might be still convenient the resort to market when the cost of organizing internal offices is prohibitively high compared to the expected production of intellectual property rights and commercialization potentials.

Many of them start now from the point U.S. leading universities were in the '70s and '80s, in terms of experience and relationships with the industry.

To be sure, technology transfer programs in the US started long before the enactment of the Bayh-Dole¹². For instance, the University of California (UC) technology transfer program –by far one of the most successful worldwide– had an important role for the Manhattan Project between the two World Wars. For a long period of time, licensing of faculty-generated intellectual property rights was done in a reactive (not pro-active) fashion, responding to the increasing requests of companies, which knew a certain technology had been developed within a campus or a lab. Well before the Bayh-Dole Act, there was an underground change occurring however. The U.S. continued losing industry after industry to Asian and European competition (especially German), in industries such as consumer electronics, shipbuilding and hardware manufacturing. The world market share in cars and other sectors was decreasing for U.S. companies and the battle for innovation was about to be lost¹³. In order to win the war of global competition several steps were taken. Among many interventions, universities were seen as having an enormous potential in terms of outsourcing innovation. Leading American universities such as the University of California, MIT or Stanford University had already patents and connections with industry.

At the same time –the 1970's– the genetic revolution was happening, both for fundamental discoveries in the biotech sector and for a more permissible approach to patenting adopted by U.S. courts. In 1976-1978, Stanford and UC filed for the Cohen-Boyer patent. In the same years, Boyer co-founded Genentech. A boom in information technology and telecom followed the one in genetic engineering and biotech.

As American companies were discovering universities as sources of innovations, patents, and increased profitability, American universities were discovering the value of research turned into patents and technology transfer. Between 1981 and 2000, the number of inventions generated by the University of California's nine campuses and three national labs increased four times, while UC's patent licensing income increased forty times, from around \$2M to about \$80M.

After the U.S. Congress passed the Bayh-Dole Act in 1980, many other universities began setting up internal offices for the management of patent portfolios and other intellectual property rights on faculty-generated inventions. Quite importantly, universities were not the main intended addressees of the Bayh-Dole Act¹⁴. The Congress was indeed favoring the creativity of small and medium enterprises and supporting not-for-profit corporations. Here came into play U.S. universities. They showed the greatest ability in creating a strategic and enduring alliance with industry, boosting technology transfer activities.

What has grown up since the passing of the Bayh-Dole Act in terms of technology transfer activities of faculty-generated inventions can be conventionally defined as second generation of technology transfer (2GTT). We can also assume the very first generation

¹² MOWERY ET AL., 2001, [*supra* note 4], at 102.

¹³ J.B. BAKER, *Fringe Firms and Incentives to Innovate*, 63 ANTITRUST L.J 621 (1995).

¹⁴ W.M. SAGE, *Funding Fairness: Public Investment, Proprietary Rights and Access to Health Care Technology*, 82 VA. L. REV. 1737, 1748 (1996).

being that when commercialization of scientific results was done in a more passive, sporadic, unstructured way.

What we referred to as 2GTT is mainly grounded on a linear, unidirectional process of innovation, where research is done remotely within labs and campuses; it happens to generate invention disclosures, hopefully turned into patents, which are eventually commercialized. See [Table 1](#) for illustration. Basically, under this setting, technology transfer is still conceived as a by-product of research conducted within universities and other public institutions. Accordingly, there is no direct connection between research and the intended outlet of its results –that is, the market– via technology transfer. In this way, professors and research personnel undertake R&D programs and, by time to time, they realize some of their technologies are worth protection and patentable. As in the majority of cases, universities' employees are bound to disclose their inventions to the university, which usually elects to retain legal title on them by statute. When this occurs, professors report their discoveries and inventions to TTOs' officers that take care of evaluating the invention, of assisting the inventors in specifying their creations and in writing appropriate claims for patents. Eventually a patent application is filed. Interestingly, as some studies have demonstrated, even if the law binds professor to disclose inventions, technology transfer personnel has to invest heavily in encouraging faculty members to disclose inventions¹⁵. The reason for such inertia (and the need for encouragement) may depend on the unawareness of professors about the invention and its patentability, on their adversity to patenting and intellectual property protection for the results of science, or simply on their laziness¹⁶.

Institutional ownership of faculty-generated inventions means the university is supposed to go about identifying potential licensors for the inventions and to ensure patents find their way to the market. When an industry is found which is willing to develop the technology, a licensing agreement is negotiated and executed and usually royalties earned by universities are shared on a variable basis with the inventor¹⁷. Alternatively, the same inventors might have an interest in starting their own company to exploit the technology. In such a case, universities still play an important role, as licensing is done in favor of the spin off company and usually equities are accepted as consideration. Moreover, sometimes universities have incubators, which provide assistance in the start up stage of the company's life.

It is not useless, incidentally, to emphasize that institutional ownership (as opposed to individual ownership) of professors' inventions is economically efficient as universities can

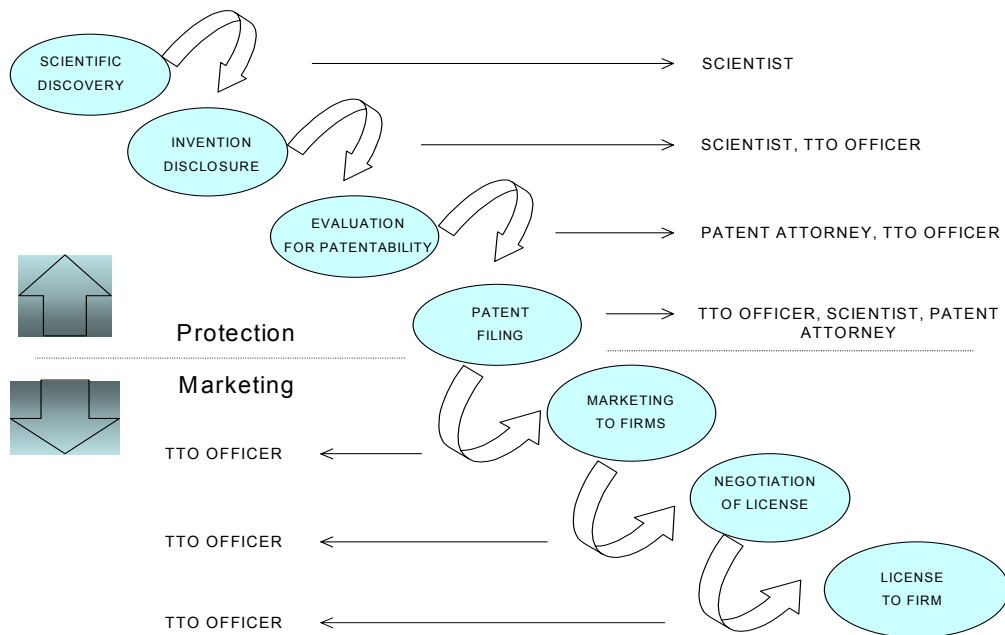
¹⁵ Cf. SIEGEL ET AL., 1999, [*supra* note 5], at 6.

¹⁶ Indeed, some scientists have complained (SIEGEL ET AL., 1999, [*supra* note 5], at 34) about the fact they do not receive in the course of their studies an appropriate or even rudimentary education on patents and intellectual property. If this holds in the U.S., where the patent culture is generally stronger, a more encouraging situation is unlikely in Europe. Usually professors learn about intellectual property at their own expenses, after going alone through the all procedure of patent protection and licensing to the industry.

¹⁷ It seems the payments made back by universities to professors are based on equitable reasons, as the inventor thus enjoys the fruits of her work, despite the ownership is in first place institutional. However, this is a quite sensitive issue, strongly influenced by the assumption that public-funded research has internalized all risks of failure and no incentives whatsoever should be awarded. On this ground, it can be argued, as many do, that intellectual property rights are superfluous in the field of public research, because there is no need for *ex post* incentives. For more discussion on this point, see *infra*, par. 6.

appropriate all positive externalities created by research and re-distribute them internally¹⁸. Of course, universities encounter limits in their efforts to market their patents portfolios, as an aggressive policy towards industry would clash with the main educational mission and with the not-for-profit nature of the institution itself. Nonetheless, title on the inventions is a no replaceable ingredient for command and control in technology transfer activities.

TABLE 1¹⁹



4. LESSONS FROM THE PAST, LEADS FOR THE FUTURE. TOWARDS A NEW GENERATION OF TECHNOLOGY TRANSFER.

In terms of results, traditional technology transfer is not optimal. The occasional character of innovation production under the above-sketched scheme determined over the years a significant amount of patents, but a relatively modest number of licenses, which

¹⁸ This is also the reason for universities to set their own technology transfer program; see SIEGEL ET AL., 1999, [*supra* note 5], at 3.

¹⁹ The model is a modified version of SIEGEL ET AL., 1999, [*supra* note 5], at 3.

less-than-compensates all investments done in R&D²⁰. In other words, universities have continued to produce technologies, some of them extremely good, and, on the other end of the market, industries and venture capital have persistently sought technologies. Nonetheless, only occasionally under such approach the demand for innovation meets the supply and as a consequence we observe universities' patent portfolios increase and many financial resources go underutilized. As a matter of fact, TTOs are not always able to license a patented invention. Actually, the ratio between patents issued and licenses granted is far from being one to one. Of course, few licensed inventions can generate significant amounts of money for universities and more-than-compensate technology transfer undertakings²¹. The University of Florida is very well known for the non-trivial royalties earned almost only by licensing the patent for the energetic drinking 'Gatorade'. Nonetheless, in general the great bulk of patents tend to remain uncommitted²². Since patent filing and administration are expensive, large patent portfolios remaining unexploited represent a sunk cost for universities and, eventually, a loss of social welfare. Moreover, all R&D investments do not have the appropriate impact on the economy, either locally or globally.

The overproduction of patents can have also side effects, when the intellectual property protection in fact 'locks' a given technology. While this is the natural consequence of all patents, because of their very nature of legal monopolies, keeping the Rembrandts in the attic may become the equivalent of passive strategies adopted by private companies to raise patent walls, and prevent competitors from entering the market by means of intellectual property rights, or to enhance their power in cross-licensing deals²³. Apart from all antitrust concerns, which can arise out, defensive strategies in patent management might be compatible under certain conditions with the purposes of the private company; they are certainly incompatible with the mission of disseminating knowledge endorsed by universities.

There are other minor, though serious, drawbacks shown by 2GTT. One rather severe problem is related to the involvement of professors/inventors in the commercial deployment of their inventions, either by licensing or by spin-off companies. In such scenario, compelling marketing reasons and trade secrecy can take over the more collaborative and internationally oriented dimension of science. It has already happened that former colleagues working on the same research project became competitor in the marketplace on a later stage once involved in the marketing of the technology. Even worse, sometimes patents are litigated and, of course, in the event of litigation relations go

²⁰ According to THURSBY ET AL., 2000, [*supra* note 6] at 6, the propensity to patent is an index for the commercial aggressiveness of universities' administrations.

²¹ The relationship between patented inventions, executed licenses, and revenues per contract is largely uneven, as it is shown, as far as the University of California system is concerned, in greater detail in UC Technology Transfer Annual Report 2001, for the last fiscal year, available on the internet at the following location: <<http://www.ucop.edu/ott/ars/ann01/ar01.pdf>>. In general, see also THURSBY ET AL., 2000, [*supra* note 6] at 7.

²² THURSBY ET AL., 2000, [*supra* note 6] at 11, report that the number of licenses executed is decreasing against the number of those offered to the industry and this is probably due to the decreasing quality of university patents.

²³ See K.G. Rivette, D. Kline, REMBRANDTS IN THE ATTIC, Cambridge: Harvard University Press, 2000.

definitely awry. Under an all-or-nothing approach, some may argue that this is a valid argument to stop all technology transfer activities and return to a regime of free appropriation of scientific results. Modern economies could not afford such a conclusion. A more serene way to look at the problem calls for caution and a deeper understanding of it recommends other possible solutions. Indeed, a good technology transfer practice is helped by professors in marketing their technologies: «faculty members are frequently involved in the marketing phase because they are often in a good position to identify potential licensees and because their technical expertise often makes them a natural partner for companies that wish to commercialize the technology»²⁴. There is, however, a problem of keeping control of such an involvement and to define the right trade off between unchecked participation and total abstention.

Lastly, after some twenty years of constant growth since the passing of the Bayh-Dole Act, the income from technology transfer based on traditional licensing has become flat and such trend is a further reason to put under revision the traditional technology transfer techniques as distinctive form of organization for university/industry relations.

These being the main deficiencies of 2GTT, it is now to be asked about the causes. The short answer is ‘discreteness’.

Technology transfer has been functional to the licensing of few, sometime sporadic inventions in response to random inventive activities of faculties. It is still rather detached from R&D and, at the same time, too apart from market needs. In other words, 2GTT does not allow filling in efficiently and exhaustively the gap between research and the market. Its remoteness from the needs of the industry does not provide directions back to the research, so that the production of innovation continues to be partially untargeted. Since market’s needs are not identified, doing transfer of technology in a not oriented way may cause a double risk: *a)* on the one side, some specific needs can remain not addressed; *b)* on the other, some areas may present an undue concentration and a wasteful duplication of R&D activities can consequently result with obvious, overproduction of patents.

Technology transfer needs not to be the end of the chain, it should rather be seen as one of the elements of a unified virtuous strategy, where all steps are actually intertwined and coordinated and each one provides the other with useful inputs and feedbacks. The model of innovation to look at is not a linear one, rather a circular one, in which not only positive externalities created by R&D programs are more efficiently appropriated, but also a mechanism to transmit signals back to research is worked out. This, of course, implies a more creative approach in dealing with industry, as opposed to the conservative approach so far showed by technology transfer offices²⁵.

The way to realize a more effective technology transfer is to shorten the distance between applied research and the market and this can only be done by welding technology transfer to R&D planning. In other words, when defining and implementing strategies of research and development of new technologies, decision makers should already have a better understanding of the future needs of the market. Because technology transfer people

²⁴ SIEGEL ET AL., 1999, [*supra* note 5], at 7.

²⁵ SIEGEL ET AL., 1999, [*supra* note 5], at 11, note that the conservative attitude of licensing officers in structuring deals stems from their commitment to the role as guardian of the university’s intellectual property. Such inflexibility is consistent with the bureaucratic organizational culture of the university.

are in touch with the industry, they are well positioned, together with professors, to provide R&D planning on market's present and expected requirements.

If it were only a matter of providing inputs to those in charge for defining investments in R&D, it would not be appropriate to speak in terms of new generation of technology transfer. It would not be technology transfer at stake at all. Scientists, professors, and researchers are in principle always free to define their own objectives and to shape them after, real or foreseen, market's needs. They do not need technology transfer offices to accomplish that. What is suggested here is a bottom-up approach to a more effective and market-oriented R&D by means of more a proactive technology transfer strategy. All passages are outlined in [Table 2](#).

The basic idea is that, first of all, TTOs have to start assessing the existing intellectual property right portfolios and undertake an explorative due diligence²⁶. Usually, even small universities have patents and patent families, which can be used as a starting point. In other words, the scheme proposed here is workable also if universities have not yet entered the 2GTT.

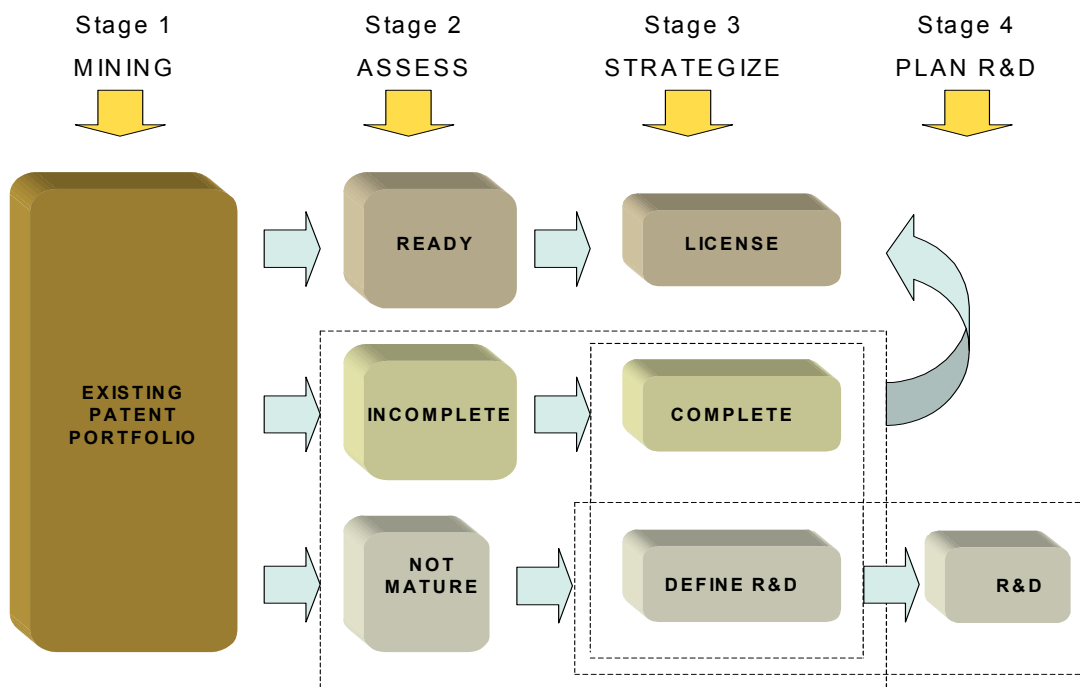
Once the portfolio has been screened out, three situations can occur: 1) some technologies are ready to be marketed and licensed. It is very likely that patent portfolios contain untapped patents, due to the unchecked quantity and the variety grown over the years; 2) some patents refer to a technology which appear to be incomplete. It might well be that they are small pieces of a broader technology, which needs to be combined with others to form a more comprehensive patent portfolio licensable. In such a case, the further step is the research for complementary technologies in other's patent portfolios. This strategy implies cooperation with research institutions or industries, which actually hold part of the complementary technology; 3) some patents refer to a technology that appears to be not yet mature for commercialization. This is exactly the stage where the existing technologies can provide inputs for research in at least two different ways. First, a research can be mapped out and designed to complete the available technologies up to the point when they become ready to be licensed. Second, the TTO officer should be able now to say why the patents found are not good for the market, the portion missing, and redirect future research efforts to alternative technologies. Quite importantly, the TTO officer plays in both cases an important role in defining the time-to-market –that is, in determining how long it would take to bring a brand new technology or an improved pre-existing one on the market.

It should be clear that although stages 2) and 3) are the distinctive stages of any new generation technology transfer they are almost never parallel. Technologies can be immature and incomplete in many respects and on different scale at the same time. In such condition, they can be held by different research institutions and appear in a quite disintegrated fashion. In fact, this can translate in a call for a cooperative and integrate strategy of complementing scattered technologies and defining joint research projects with *all* those somehow interested. A closer, cut-across interaction among a plurality of actors comes into play as a distinctive feature of the new generation of technology transfer.

²⁶ If the portfolio is particularly large and multi-technology it can be worth recurring to specialized software for patent mapping.

It is self-evident that as long as technology transfer is an occasional activity, passively functional to research and not determinant of R&D planning, inter-institutional cooperation has scarce or no value. Everything is conducted internally and there is no need to interface with other campuses, regionally or internationally. Because science and research are international almost by definition and faculties cooperate in the framework of broader R&D projects, backward integration of technology transfer with R&D planning causes the former to become as international as research. Thus, when adopting a new generation setting for technology transfer, universities must be aware that additional problems may arise and a more careful approach is in order. Some of these difficulties are expressly addressed in par. 6.

TABLE 2



5. SOME PRECAUTIONS.

There are few things that should be really avoided in pursuing a more innovative technology transfer policy, either within a starting or within a continuing operation.

First of all, the management of technologies, from the very moment of an invention's disclosure to the licensing of the resulting patent is such a complex and demanding activity which none can afford doing it in an unprofessional manner. This should read more as a warning for universities willing to start from scratch their (effective) technology transfer

program, because sometimes, especially in smaller campuses, a too naïve approach has been followed, with few, not specialized resources actually committed²⁷. There are also objective reasons for such an approach: universities might feel the need for an internal office somehow assisting professors in their inventive activities, and, at the same time, the need to limit expenditures for an operation that is not expected to produce significant revenues due to the dimension of the campus and the scarcity of invention disclosures.

Much of the core of all commercial relationships between universities and industries and between faculties and technology transfer offices is built upon responsive and proficient structures and procedures. What an efficient structure is expected to do is a timely job to gather as many patent disclosures as possible, to assess them, to decide for protection (or not), and to bring them to commercialization as soon as possible²⁸. Some studies have reinforced the idea that ‘time-to-market’ is a crucial factor for entrepreneurs that need technologies, since securing them, once promptly and opportunely protected, translates into a terrific competitive advantage²⁹. Unfortunately, time-to-market is a concept absolutely obscure to many universities and their bureaucratic organizations. Managing professionally intellectual property rights means to act at least as fast as the market for the technologies handled. It is common to hear R&D and technology transfer labeled as ‘pre-competitive’ activities (R&D and technology transfer), especially by politicians. Whether the formula is appropriate or not is neutral in terms of an efficient practice; it would be harmful, though, if it would be used as an excuse to justify delay. There cannot be any acceleration in the market, if ‘pre-competitive’ activities move slowly³⁰.

At the same time, a quick response is also essential to attract professors. Because faculties are always keen on publishing, when faced with the need to wait too long for their inventions to be protected, they would likely turn towards the alternative of publishing³¹. Hence bureaucracy generates also under-reporting.

If there is a mistake that can be done in building a technology transfer practice, not taking things seriously is probably the worst. Unfortunately, the market rewards efficiency over the most genuine, though naïve effort to do things³². The likelihood of success for non professional-like initiatives is poor, the risk to spoil irreversibly the always-fragile relationships with the faculty is high³³, and the university itself could be exposed to disastrous consequences³⁴. If a university administration cannot provide a satisfactory

²⁷ This trend is also witnessed by fancy names adopted for the offices.

²⁸ THURSBY ET AL., 2000, [*supra* note 6], at 13, 14, provides data according to which success in licensing activities positively influences propensity to disclose inventions by professors.

²⁹ SIEGEL ET AL., 1999 [*supra* note 5], at 12.

³⁰ This can be seen also as an explanation why the bubble of the e-economy at some point deflated. There were no sound technologies and full R&D pipelines supporting the enormous and unconstrained financial flows keen on market’s outlets.

³¹ As pointed out by THURSBY ET AL., 2000, [*supra* note 6], at 4, «[i]n some cases faculty may not realize the commercial potential of their ideas, but often they do not disclose inventions because they are unwilling to risk delaying publication in the patent and license process». This explains why industries often resort to delay of publication clause in their university contracts.

³² On such meaning of efficiency see SIEGEL ET AL., 1999, [*supra* note 5], at 30.

³³ For more discussion see, *infra*, § 6.

³⁴ Just to name a couple of risks: liability for defects due to the technology and for patent infringement.

budget for its technology transfer program, then it is probably worth opting for the buy, rather than sticking on the make.

Secondly, when adopting a pure 2GTT scheme as described above (see par. 3) to accomplish a technology transfer program, satisfactory results should not be expected in the short-run³⁵. Indeed, because a critical mass of intellectual property rights is always required before an adequate number of licenses is executed and starts bringing money in, the break even could probably be met in the mid- long-run, depending also on luck and on the intensity of learning by doing. Accordingly, because revenues only come at a later stage, a technology transfer action in general is inevitably a losing business at the beginning. It goes without saying: as a consequence, waiting too long is the second worst decision that could be taken.

Of course, everything would shape out differently adopting a more integrated approach to technology transfer, having R&D programs immediately conceived as potential source of intellectual property and even undertaking scouting activities internally before defining R&D strategies.

6. DIFFERENCES AND BIASES (NOT ONLY) IN INTERNATIONAL COOPERATION.

There are quite a few difficulties in general that any technology transfer undertaking is likely to encounter; likelihood blurs into inevitability whenever technology transfer is truly integrated with research and development in a market-oriented bundle. First and foremost, differences in culture among co-operators, although hardly measurable and foreseeable in advance, do matter and can give rise to clamorous failures. A part from that, more serious unevenness paves the way towards integration and cooperation.

Probably the most problematic issue is the one concerning the compatibility among the aims of public funded research and the idea of private appropriation underlying intellectual property regimes; such an issue gave raise to a debate not yet settled³⁶. Put in other words, the question turns out to be: are patents and science at odds? Is there an intimate conflict between the purposes of free divulgation of the latter with the legal monopoly granted with the former? The issue is too complex, multi faceted and much more worth discussion to be dealt with here in few, scant words. Nonetheless, it is not pointless to remember that a more collaborative approach to disclosing inventions and obtaining patent protection strongly depends on inventors' beliefs about the relation between patent and science³⁷. Of course, in the process of setting up new generation in R&D and technology transfer, the presence of groups of researchers with different views on this very issue can result in the impossibility to even start any cooperation.

Incidentally, it is safe to say that probably the debate is biased in two senses. First, there is not ontological difference between public and private research and, as a consequence,

³⁵ For figures on expenses and resources see SIEGEL ET AL., 1999, [*supra* note 5], at 17.

³⁶ For more details on the debate see A.K. RAI, *Regulating Scientific Research: Intellectual Property Rights and the Norms of Science*, 94 NW. U. L. REV. 77 (1999).

³⁷ THURSBY ET AL., 2000, [*supra* note 6], at 5, report that one cause for professor not reporting inventions is the "philosophical" belief about the mission of academic scientists and professors. This is consistent with the interviews done by SIEGEL ET AL., 1999, [*supra* note 5], at 29.

there cannot be differences in terms of appropriation of their results. The only diversity is in the subjects: universities are supposed to disseminate science, which means that reasons of free availability need prevail on reasons of private appropriation whenever a conflict arises. The same logic does not apply within the industry, where there is a more conservative approach and usually managers and entrepreneurs do not look favorably to publication even when a patent application is already on file³⁸. Secondly, there is not a real clash between the divulgation purposes of science and the nature of patents. Intellectual property is usually depicted as a legal monopoly awarded to the inventor or the author to give them *ex post* incentives for their inventive or otherwise creative activities. Notably, the monopoly is not given for free, nor the fees for patent filing can be considered the price of the monopoly. Instead, what the legal system demands the inventor as a consideration for the grant is exactly that the invention or the creation is made available to the public. Indeed, patented technologies are nowadays on the web, accessible to anyone.

It is probably true that too a strong involvement of universities into applied research and commercialization of result can, under unrestrained conditions, bring about side effects: the research agenda can be diverted³⁹. Whereas this is a possible danger –much more material whenever professors are left alone by institutions in their contacts with the industry–, there is actually evidence that many professors are normally positively influenced by interactions with the industry; their basic research gets improved quantitatively and qualitatively⁴⁰.

Another set of differences capable of influencing integrated R&D/technology transfer cooperation is the current fragmented scenario of intellectual property regimes, especially within European Community. Often times, complementary technologies are not similarly homogeneous in terms of patent protection, so that it is hard to assemble them into an appealing patent portfolio, according to the scheme proposed above (see Table 2). This translates easily into a financial problem, as extending protection abroad is usually a matter of money. Of course, if no serious possibilities of licensing exist, which can justify the temporary, additional expenditures for patent filing in other countries, it is not worth extending the protection. At the same time, rather paradoxically, if patents available are complementary but not homogeneous to others in order to form a patent portfolio, it is almost impossible to start a co-operation. It looks pretty much like the story of the chicken and the egg, until it is recognized that the only way to increase licensing possibilities and, at the same time, to save money is to integrate technology transfer purposes into R&D planning and devote resources only towards productive uses.

Strictly related with the previous aspect is the one concerning the alternative between individual and institutional ownership of faculty-generated inventions. On the merits, there is not much to say. It is not even a serious alternative. Good sense, before and better than any other legal and economic explanation, tells us that the best situation holds when the

³⁸ See SIEGEL ET AL., 1999, [*supra* note 5], at 32. The reason for such cautious approach is comprehensible in light of the very nature of scientific knowledge. There is always the risk that divulging information about the invention might determine a lost of a portion of knowledge not perfectly wrapped by the intellectual property right.

³⁹ THURSBY ET AL., 2000, [*supra* note 6], 18, say no. The danger is deemed true by CHEW, *Faculty-Generated Inventions*, cit., 285.

⁴⁰ SIEGEL ET AL., 1999, [*supra* note 5], at 31.

university retains title over the inventions done by its professors⁴¹. It is fair, efficient (universities appropriate positive externalities created by a research), it short-circuits many of the problems highlighted above. In most, if not all, western civilized countries the rule is one of institutional ownership, even though, by time-to-time, odd movements tend to reconsider the suitability of the norm⁴².

Technically, it can be indeed difficult to start assembling patents into marketable portfolios or to coordinate groups of researchers when different rules exist on the ownership and parties cannot set down an alternative legal regime, due to the mandatory nature of the rules. The problem is particularly tricky whenever funding agreements with funding institutions provide for intellectual property rights with reference to the regime applicable to the researchers taking part to the research. In this case, additional administrative and transaction costs are to be incurred to contract around the existing rules. Especially within the European Community, there is room for harmonization, since differences in regime can jeopardize the purpose of structuring the European Research Area⁴³. In the Proposal for a Directive of the European Parliament and the Council on the patentability of computer-implemented inventions there is a shy acknowledgment of the importance of having a harmonized system of ownership⁴⁴. Although this is a first, important step, it is not yet enough and the EC should consider more seriously the adoption of a directive addressing this specific issue.

7. CONCLUSIVE REMARKS.

This paper has dealt with virtues and vices of traditional technology transfer. Such scheme firstly developed in the U.S. when universities were given the right to retain title on faculty-generated inventions. Unfortunately, that generation of technology transfer is too remote from the market. As a consequence, universities continue to produce intellectual property rights, but few licenses are executed. Even if royalties are earned, the system is not producing optimal outcome. A more effective technology transfer program has to be integrated in R&D and provide inputs on market's needs when R&D plans are mapped out.

⁴¹ For more discussion on this point in a comparative perspective see, in Italian, M. GRANIERI, *Circolazione (mancata) dei modelli e ricerca delle soluzioni migliori. Il trasferimento tecnologico dal mondo universitario all'industria e la nuova disciplina delle invenzioni d'azienda*, in *Riv. dir. ind.*, 2002, 63, and, in English, ID., *Patent and Technology Transfer. Law, Economics, and Policy*, paper presented at the Haas School of Business, University of California at Berkeley, 2002 (forthcoming).

⁴² Recently in Europe there have been interesting changes. Italy has opted for a criticized regime of individual ownership, whose only virtue was the increase of administrative costs for universities and worries on the part of professors. See Art. 7 of the Italian Law No. 383 of October 18, 2001 (in OJ No. 284 of October 24, 2001). Germany, instead, repealed the so-called professors' privilege (*Hochschullehrerprivileg*), implementing an institutional ownership solution. See *Gesetz zur Änderung des Gesetzes über Arbeitnehmererfindungen* on January 18, 2002 (Bundesgesetzblatt Jahrgang 2002 Teil I No. 4). Quite interestingly, the reason for Germany changed the law was its modest results in term of innovation.

⁴³ See Decision No. 1513/2002/EC of the European Parliament and of the Council of 27 June 2002 concerning the sixth framework programme of the European Community for research, technical development and demonstration activities, contributing to the creation of the European Research Area and to innovation (in OJ L 232/1 of August 29, 2002).

⁴⁴ COM (2002) 92 final.

The new generation of technology transfer is supposed to weld the research to the market and make sure the innovation produced within universities has eventually an impact on the economy and on society as a whole. When adopting such new approach, cooperation, both at regional and international level, becomes a key factor. Accordingly, complexities usually grow and a certain number of biases and wrong beliefs are usually met, which can jeopardize the success of the operations. This paper provides also for some advices on how to deal with them.

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