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University Technology Transfer in Switzerland

Organisation, Legal Framework, Policy and Performance

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Center for Science and Technology Studies
Zentrum für Wissenschafts- und Technologiestudien
Centre d'études de la science et de la technologie
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Vorwort

Kontext:

Geistige Eigentumsrechte stellen Anreize für intellektuelle und innovative Tätigkeiten dar, indem sie dem Eigentümer ein Monopol zur Verwertung der Resultate einräumen. Auf diesem Hintergrund ist die Verwertung von Wissen aus öffentlich finanzierter Forschung weltweit wie auch in der Schweiz in den letzten Jahren immer wichtiger geworden.

Projekt:

In den letzten beiden Jahren hat die OECD mit einigen ihrer Mitgliedsländer das Projekt „The Strategic Use of IPRs by Public Research Organisations" durchgeführt[1]. In diesem wurden drei Module behandelt:

1) Bestandesaufnahme und Bewertung der rechtlichen Regeln zur Kommerzialisierung von öffentlich finanzierter Forschung,

2) Umfrage über die Patent- und Lizenzaktivitäten bei Hochschulen und anderen öffentlich unterstützten Forschungsorganisationen, und

3) Fallstudien zur vertiefenden Analyse ausgewählter Aspekte.

Resultate:

Als Synthese hat die OECD in 2003 die Publikation „Turning Science into Business. Patenting and Licensing at Public Research Organisations" herausgegeben, welche einerseits die rechtlichen Regeln sowie die Empirie bezüglich Patenten und Lizenzen im internationalen Vergleich darstellt und auswertet, und andererseits die vertiefenden Fallstudien wiedergibt. Der vorliegende Aufsatz ist ein Abdruck von Kapitel 10 aus diesem Band (S. 189-201). Die Resultate der Umfrage zu den Patent- und Lizenztätigkeiten im Schweizer Hochschulsystem sowie die Regeln zur Kommerzialisierung von öffentlicher Forschung wurden schon früher veröffentlicht[2,3].

[1] Das Projekt wurde auf Antrag des Committee on Scientific and Technological Policy (CSTP) durch die Working Party on Innovation and Technology Policy (TIP) der OECD durchgeführt.
[2] Vock, P, Jola, C. (2002) Patent- und Lizenzaktivitäten 2001. Umfrage bei Hochschulen und anderen öffentlich unterstützten Forschungsorganisationen. CEST 2002/12.
[3] Die Rechtsregeln sind nur über Internet verfügbar: www.cest.ch.

Chapter 10

UNIVERSITY TECHNOLOGY TRANSFER IN SWITZERLAND ORGANISATION, LEGAL FRAMEWORK, POLICY AND PERFORMANCE

by

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Introduction

At present, technology transfer activities in Swiss higher education institutions are bottom-up and based on decentralised decision making. This leads to different institutional solutions for technology transfer as well as a legal framework that lacks simplicity and clarity. Nevertheless, in international comparisons, Swiss technology transfer performs quite well. Is this a contradiction, as one would assume at first sight? Recent studies[2] shed more light on the conditions, mechanisms and extent of technology transfer in Switzerland. This chapter examines these insights and tries to address the apparent contradiction. It first describes the context and organisation of technology transfer and then analyses the legal framework. After discussing the policy relevance, the most recent empirical evidence on technology transfer is summarised. Some conclusions follow.

Context for and organisation of technology transfer at universities

To better understand the discussion of technology transfer and related policies, the following paragraphs give some background concerning the institutional settings in which technology transfer operates.

Heterogeneous institutional context

Commercialisation of the results of publicly supported R&D in Switzerland involves many actors, visions, mechanisms, etc. A vital precondition of technology transfer is the performance of research. In 2000, R&D worth around CHF 10 billion was carried out in Switzerland, around three-quarters of which was performed by the enterprise sector (CHF 7 890 million), almost one-fifth by the higher education establishments (CHF 2 025 million) and only a little more than 1% by the federal state (CHF 140 million) (BfS, 2002). Publicly funded research is performed by a variety of organisations that differ in terms of their profile and subordination (see Box 1).

Box 1. Players in publicly funded research

The higher education sector comprises two federal institutes of technology (ETH) under federal authority, ten cantonal universities under cantonal authority and seven universities of applied sciences under cantonal or inter-cantonal authority. Some 70% of the R&D expenditures of the higher education sector (CHF 1 935 million[1]) are financed by the regular university budgets (financed by the federal state and the cantons), 10% by the Swiss National Science Foundation (mostly competitive project funding for basic and oriented research) and 20% by other (external) sources (including private sector funding, funding for joint applied research with firms co-funded by the Commission for Technology and Innovation and some project funding from a few federal offices). The autonomous Swiss universities are part of a governance system jointly managed by the federal state and the cantons. The organisations differ in their objectives, size, resources, disciplinary orientation, hierarchical subordination, and reform dynamics and hence their technology transfer activities.

Organisations other than higher education institutions that receive public funding for R&D include four fully funded federal research laboratories associated with the federal institutes of technology, as well as a dozen organisations receiving money under the research law. These include the European Organisation for Nuclear Research (CERN) as well as specialised research organisations such as the Swiss Centre for Electronics and Microtechnology (CSEM) and the Swiss Institute of Bioinformatics (SIB).

1. R&D expenditures of the universities of applied sciences are not included.

Organisation and management

Technology transfer is an issue in all Swiss universities, although its priority varies. The institutionalisation of the technology transfer however differs considerably according to size, strategy and subordination of the university (see Box 2). Normally, a person or an internal or external office is in charge of technology transfer for the whole institution. These activities are often supplemented by those of subunits such as departments or schools or even by the scientists themselves. Most technology transfer offices (TTOs) are less than ten years old. They generally only deal with intellectual property (IP) management for their home institution. For the cantonal universities, some TTOs manage IP for several institutions. TTOs are involved in a broad range of technology transfer activities of which negotiating research agreements is most common and licensing-in the least common. The negotiation of research agreements is a support activity for university staff and is hardly ever initiated by the TTO.

Box 2. Different institutional forms of technology transfer: some examples

Tertiary education and research bodies under federal control, *i.e.* the two federal institutes of technology and the research organisations, have all chosen to institutionalise their technology transfer and licensing activities as offices within their organisation.

In contrast, cantonal universities have a variety of institutional solutions. Technology transfer activities of the universities of Zurich and Bern are carried out by a non-profit limited company that is entirely owned by these universities. Via a co-operation agreement, a university of applied sciences and an institute of a federal office can also use its services. The technology transfer activities of the university of Basle are – as in many other universities – under the control of the rector's office, usually under the vice-rector in charge of research. The university document establishing the TTO left open whether an internal office or an external company would perform this task. For now, the university has assigned it to a private company which also carries out technology transfer for a university of applied sciences as well as other activities. The universities of Geneva and Lausanne have their own internal TTOs, that of Lausanne established together with the cantonal hospitals.

In late 1999, the Swiss Network for Innovation (SNI) was established on the initiative of the State Secretary for Science and Research. The goal of the foundation is to support tertiary education organisations in their technology transfer activities. All cantonal universities, the federal institutes of technology, the universities of applied sciences, other research institutes as well as private companies are members of the network.

Incentives to commercialise

Different factors influence researcher's propensity to commercialise their results. There is a potential tension between the academic and business cultures owing to the different goals of "first to publish" and "first to apply". The patenting and licensing survey (Vock et Jola, 2002) showed that IP and licences rarely influence recruitment, career advancement or the researcher's income. However, there must be other incentives to commercialise since the survey showed that especially in higher education institutions, in addition to the official TTOs, institutes and individual researchers are involved in IP activities. Naturally, the ownership rules that apply to intellectual property are important. These are analysed in the next section of this chapter.

Legal framework for commercialisation

The legal situation governing the commercialisation of university research results is quite complex. No comprehensive overview is readily available. The patent and licensing survey conducted in 2002 included a question on IPR rules which shows that the intellectual property resulting from research often belongs to the organisation. Furthermore, ownership depends on the type of contract or is attributed to the organisation or firm that financed the research. A special analysis[3] was needed to capture the details of the legal regime for commercialisation. The ownership rights for IP in the Swiss higher education sector are summarised below. Following a short description of the principles for IP ownership involving students, a more in-depth analysis of ownership rules for employees is undertaken.

Ownership rules under Swiss IP laws and their modification through organisation-specific rules

As in other countries, intellectual property is regulated in special national laws. Separate laws exist for different categories of IP, such as patents, designs, plant varieties, trademarks, copyright and topographies of semiconductor products. These laws specify the ownership of IP at the time when it is created. Depending upon the category, different owners are defined. These rights can be transferred. The ownership rules for intellectual property specified in the IP laws can be modified through other regulations in the higher education sector, especially with respect to registration or employment at higher education institutions.

Ownership rules for students

Rules determining the ownership of IP arising from activities of registered persons such as students theoretically may be found at various levels in different regulations (university laws, regulations of institutes, etc). In reality, almost no rules are laid down at the highest possible level of a given institution (but they may exist at a lower level). When no general or specific rules concerning IP ownership exist, the IP belongs to the creator of the IP, thus the student. If the student is employed in some manner by the institution, different rules apply, depending on whether the IP was created as part of the student's studies or employment.

Ownership rules for employees

Frequently, the rules concerning employment contracts determine the ownership of IP. There is no common rule for the different IP categories or for private and public organisations. Although the

focus here is on PROs, the rules for the private sector are explained to show the differences. Table 1 gives a synopsis of the ownership schemes that apply.

Table 1. Ownership rules and owners in the case of an employment relationship

	Employment relationship based on private law	Employment relationship based on public law
Inventions	Ownership rule according to employment contract Subordinate: OR 332 (owner: employer)	Ownership rule according to public regulations Subordinate: patent law (owner: inventor, *i.e.* employee)
Designs	Ownership rule according to employment contract Subordinate: OR 332 (owner: employer)	Ownership rule according to public regulations Subordinate: design law (owner: designer, *i.e.* employee)
Plant varieties	Ownership rule according to employment contract Subordinate: OR 332 (owner: employer)	Ownership rule according to public regulations Subordinate: Law on the Protection of New Plant Varieties (owner: plant breeder, *i.e.* employee)
Works (copyright)	Ownership rule according to employment contract (transfer of rights according to purpose of contract) Subordinate: copyright law (owner: employee)	Ownership rule according to public regulations (transfer of rights according to purpose of contract) Subordinate: copyright law (owner: employee)
Software	According to copyright law transfer of rights to use to the employer For this transfer of rights no special rule is needed in the employment contract	According to copyright law transfer of rights to use to the employer (this is controversial) For this transfer of rights no special rule in the employment contract is needed (this is controversial; thus with the absence of a public rule a legal uncertainty occurs)
Trademarks	The applicant is owner The employer must make sure that the application is in his name.	The applicant is owner The employer must make sure that the application is in his name.
Topographies of semiconductors	The producer, *i.e.* the employer, is the owner	The producer, *i.e.* the employer, is the owner

Note: OR = Swiss Code of Obligations (*Obligationenrecht*); Public regulations means: 1. General rule, such as a law, 2. individual agreement, such as a public employment contract.

In the case of inventions, designs, plant varieties and copyright-protected work, similar reasoning applies. The rules specified for the employer-employee relationship under scrutiny are decisive for ownership. If there are no such rules, "fall back", or subordinate, regulations apply.

In substance, for employment contracts under private law which apply to firms, the IP rules of these contracts apply. If no rules are specified, the Swiss Code of Obligations (which regulates contract law) stipulates that ownership of inventions, designs and plant varieties belongs to the employer. In the case of works, ownership is attributed to the creator of IP, *i.e.* the employee, under the copyright law.

In the case of employment contracts under public law (applicable for most higher education institutions), IP ownership is determined by public rules, if they exist. These public rules can either be general in character, *e.g.* laws or other regulations, or they may relate to the specific public employee contract. If there are no specifications for IP ownership, then the rules of the relevant IP laws apply and ownership belongs to the inventor, designer, plant breeder or creator of the work, *i.e.* the employee.

Software is protected under copyright law but with some particularities. By law, the employer is explicitly given the right to use the software. This is certainly true for private firms, but in the author's

view it also applies to higher education institutions as employers (but this is somewhat controversial). Trademarks and topographies of semiconductors belong to the employer.

IP ownership rules for employees at different higher education institutions

As indicated in Table 1, IP rules in higher education institutions are very much dependent on what is found in the relevant public law (such as university laws or cantonal public employment laws). Analysis of institution-specific rules as well as the subordinate rules of the specific IP laws yields the relevant ownership rules for individual universities.

Almost all higher education institutions follow some public rules that determine ownership at least for one IP category. Decrees that cover all IP categories are not very common.

Most higher education institutions have rules for inventions, and most often they retain ownership for the institution. On some occasions, the rights are attributed to the cantons or the inventors. One-third of all higher education institutions have rules for the ownership of designs, copyright-protected works or software. Ownership sometimes varies with employment status (professor, assistant, technical personnel, etc.).

Ownership rules for external funding

University research often involves external funding. The inclusion of a third external party may modify IP ownership rules. Therefore, some higher education institutions have issued rules concerning external project funding. Generally, these principles leave room for adaptation in the contract negotiated with the organisation sponsoring the research. The most important public funding agencies have created standard rules concerning intellectual property rights (IPRs), which can, however, be modified by rules in individual contracts. The Swiss National Science Foundation, which sponsors pure and oriented basic research, as well as the Commission for Technology and Innovation, which co-finances joint academia-industry-projects, waive their rights. The funding for policy-oriented research by the government does not follow any standardised rules.

A national rule exists but is not binding

The previous discussion of ownership rules shows quite clearly that in Switzerland, no standardised and unified ownership rule exists, either for all higher education institutions or for all categories of intellectual property. This is because the institution-specific rules usually do not cover all IP categories and because the regulatory competence in the higher education sector is split between the state and the cantons.

Nevertheless, an attempt has been made to standardise ownership rules. The national research law specifies that the granting of federal funds can be tied to the condition that IP rights must be transferred to the employer. However, this rule is not binding.

Policy relevance of technology transfer and the legal framework

In the Swiss political arena, knowledge and technology transfer activities involving higher education institutions are seen as beneficial, but this is not a widely debated issue. In 2002, two reports

taking stock of the various arguments and the present status of economic growth and innovation in Switzerland were issued. In the growth report (Seco, 2002), issued by the office in charge of economic policy, innovation is singled out as one important driver of growth. Protection of IP is mentioned very generally as an important precondition for innovation. But technology transfer by higher education institutions and the legal framework are not discussed or analysed in detail. In addition, when discussing the barriers to innovation, the rules for intellectual property are not mentioned.

In a more specific report on innovation in Switzerland (BBT, forthcoming), issued by the office in charge of innovation policy, special emphasis is placed on the application of knowledge and the strengthening of the interface between industry and academia. It is explicitly mentioned that owing to the different characters and goals of the various higher education institutions it would be inappropriate to commit them to a uniform transfer policy. It should be left to the institutions themselves to find optimal solutions. Nonetheless, the report urges the need to study the question and recommend measures to facilitate and reduce costs of the protection of intellectual property.

Thus, it is not surprising that the national innovation policy emphasises the importance of knowledge and technology transfer but not via a uniform technology transfer policy. For the period 2000-03, the Swiss government[4] set five strategic goals for tertiary education, research and technology, one of which is the valorisation of knowledge (Bundesrat, 1998). Three measures affecting technology transfer were proposed: first, the introduction of standardised rules for IPRs applicable to federal funds in the research law (described above); second, amendment of the law for the universities of applied sciences with IPR rules, not to determine who owns IP but so that the partners specify this in a contract; and third, the establishment of the Swiss Network for Innovation (also mentioned above).

Then, in November 2002, the government sets three strategic goals for 2004-07, which included the strengthening of research and the promotion of innovation (Bundesrat, 2002a). The improvement of knowledge and technology transfer as well as of the interface between science and industry has taken on greater importance, with many more references than in the earlier policy document. The previous changes (legal changes in the research law and the establishment of the SNI) are judged successful. The new policy thrust is the substantial augmentation of funds for basic as well as applied research, financed by the Swiss National Science Foundation and the Commission on Technology and Innovation. A minor change in the research law establishes the competence for federal expenditures to valorise knowledge (the financing of the SNI as well as a technology information platform).

To summarise, change to the legal rules for intellectual property arising from higher education institutions is currently not a priority of federal policies. This assessment is in line with the recommendations of the advisory body to the Swiss government, the Swiss Science and Technology Council. In its most recent policy document, the council singles out nine policy priorities including the improvement of knowledge transfer but does not mention intellectual property rights (SWTR, 2002). In 2001, federal and cantonal authorities established the Swiss University Conference to co-ordinate the activities of the cantonal universities and the federal institutes of technology. The conference can take binding decisions on guidelines for the valorisation of university knowledge. This competence has not been used so far.

Besides the formulation and implementation of an overall tertiary education, research and innovation policy, the federal administration has to formulate the framework for specific higher education institutions, *e.g.* the two federal institutes of technologies. The relevant law is currently under revision. Among the changes are: to include the request to exploit research results as an objective of the institution, to give the institution the possibility to invest in firms for the purpose of knowledge transfer, and to reformulate the rules for intellectual property. The document presenting the

proposal to parliament (Bundesrat, 2002b) argues that the assignment of property rights in the current situation is not clear enough and therefore puts forward rules for all categories of IP applicable to the federal institutes of technologies. In September 2002, the Council of States discussed the proposed changes as did the first chamber of the parliament. The changes mentioned above were adopted without discussion. Only the speaker of the committee in charge of previewing the proposals mentioned the lively discussion in the committee about the pros and cons of investing in private firms and the change in the rules for intellectual property rights.

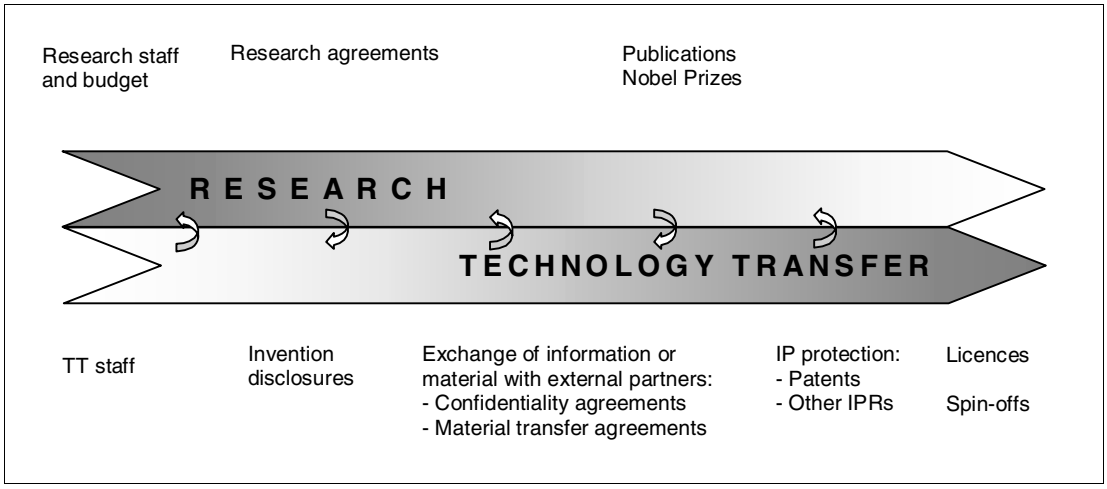
Performance of university technology transfer

Following the previous presentation of the institutional and legal setting as well as some policy initiatives, the following paragraphs discuss the actual technology transfer activities.

Empirical evidence on the technology transfer process

The recent survey on patenting and licensing activities of PROs provides aggregated data on Swiss technology transfer, the first of its kind. In general, the numbers show quite substantial technology transfer activities. However there are some difficulties in providing and interpreting the data. The available evidence is presented below in a format consistent with the technology transfer sequence (see Figure 1). Research and technology transfer are intertwined activities and parallel each other in certain phases.

Figure 1. Some Indicators for research and technology transfer



Research resources, research agreements, publications, etc.

Research is a precondition for technology transfer, and thus the volume of research is an indication of the potential for technology transfer.[5] With around 13 000 person-years engaged in R&D in higher education institutions and a budget of CHF 2 billion, Switzerland invests quite substantially in research. Unfortunately, no overall information on research agreements is available, but experts observe vigorous activity. The performance of Swiss academic research in international perspective is quite impressive given its modest size. This is well documented for example in the number of Nobel Prize winners as well as in bibliometric indicators.[6]

Technology transfer staff

A highly skilled and motivated expert staff combining various skills and competencies is necessary for successful technology transfer. Around 20 full-time equivalents are engaged in technology transfer for the Swiss universities, whose staff ranges from virtually zero to four full-time equivalents. This is a well-networked expert community.

Invention disclosures

When the first results of research appear and scientists begin considering commercialisation, a first step might be to contact the TTO of the home institution. A document which often accompanies this step is the invention disclosure. TTOs of the Swiss higher education institutions received 241 of these in 2001.

Confidentiality agreements and material transfer agreements

During research, it is often necessary to exchange information and materials with external partners such as universities or firms. These exchanges are formalised through contracts so as not to jeopardise the commercialisation of possible results. In 2001, the TTOs issued 157 non-disclosure or confidentiality agreements and 60 material transfer agreements. These figures, especially the former, most likely underestimate the situation as such contracts do not have to be concluded by the TTOs and equivalent rules are contained in many research agreements.

Patents

In 2001, TTOs filed 132 patent applications. In a single organisation, the maximum number of patent applications a year is over 40. Most patent applications are in the fields of "Health, pharmaceuticals, medical technology (including biotechnology)" and "Information technology, electronics, instruments". In the same year, 59 new patents were granted to the higher education institutions. Most new patents were issued for Switzerland or other European countries, and patenting in the United States is also common. Overall, higher education institutions have a portfolio of more than 900 active patents, and one has a portfolio of several hundred.

Licensing

In 2001, higher education institutions negotiated 200 licences, only a small portion of which were linked to active patents. Many are based on copyrighted materials (81), patent-pending inventions (33) or non-patented inventions (27).

The patent and licensing survey provided data on the patent portfolio of PROs, the licences based on the patents of the portfolio, and the licences of the portfolio that generate income. To compare these figures the data should refer to the same population.[7] Table 2 shows that one out of two patents in the portfolio is licensed. Of the licensed patents. around half earn income.

Table 2. Patents, licences, and income

	Higher education institution	Research organisation	Total
Patent portfolio	308	237	545
Patents of the portfolio which were licensed	156	96	252
Patents of the portfolio which were licensed and earn income	71	38	109

PROs reported more than CHF 8 million in licence earnings. However, income figures were poorly reported. On average, 50% of gross income goes to the research group or department where the inventor works. The remaining 50% goes to the TTO, the inventor and the central administration of the organisation.

Exclusivity is a major issue as regards exploitation and diffusion of knowledge. Two-thirds of the survey respondents have non-exclusive licence agreements, about half reported licence agreements that are exclusive for the lifetime of the patent or agreements with exclusivity limited to a specific field or market type. Less common is exclusivity limited to a specific number of years or to a specific territory. Most licence agreements provide that the licence must be worked, but not necessarily domestically. Reach-through clauses as well as rights to delay publications or of first refusal occur but are not the rule. To find licensees, TTOs and researchers most often rely on informal contacts. Licensing-in is not very common.

Spin-offs and start-ups

The creation of new firms out of the activities of public higher education and research organisations is widespread in Switzerland and has become more frequent in recent years. In almost all organisations, more or less active promotion of establishing new firms can be seen, despite some occasional impediments. Empirical evidence is scattered, but a recent study has tried to compile data for all of Switzerland (Vock, forthcoming). Given to the lack of a clear definition of spin-off, ten criteria were used to characterise the relationship between the newly founded firm and the higher education institution. Preliminary analysis shows that spin-offs most often include employees as founders or that the new firms result from the R&D of the higher education institution. This shows that spin-offs are indeed a valuable mechanism for IP transfer. New firms that licensed technologies or received equity investments from higher education institutions were less frequent. Almost 400 spin-offs were identified, most of them still active. The two federal institutes of technology play a major role contributing two thirds of all spin-offs, while cantonal universities are responsible for 20%. The rate of formation gradually increased between 1994 and 2000, and now stands at around 50 new firms a year. These figures are roughly in line with the results of the patent survey of 2001 which reports 46 spin-offs (firm founded by staff) and 22 start-ups (firm to commercialise an invention but not including staff).

Productivity

Discussions about technology transfer, especially in a political context, often lead to a demand for assessing the productivity and efficiency of the technology transfer process and for comparisons between organisations or countries. It is very difficult to describe the technology transfer process adequately and to monitor it with simple indicators. Furthermore, there is no single model of successful technology transfer. Nevertheless, indicators interpreted in context can lead to an informed

discussion aimed at improving knowledge and technology transfer. The following should be seen in this perspective.

Productivity is the relation between output and input. The first difficulty is to select output and input indicators that are meaningful for assessing the technology transfer process. For this, the intended objectives[8] of the technology transfer process are crucial, and they have to be measurable with indicators. Unfortunately, these issues have not been fully resolved, leaving room for future work. Table 3 offers a pragmatic approach, which uses available indicators.

Table 3. Comparison of some indicators between the United States and Switzerland

Input	Research expenditures	USD 29.5 bn	21	CHF 2 bn	R&D expenditures (only HEI)
Output	Invention disclosures	13 032	47	280	Invention disclosures (HEI and RO)
	US patent applications	6 375	36	175	Patent applications (HEI and RO)
	US patents granted	3 764	34	112	Patent grants

Note: HEI = higher education institution; RO = research organisation. The central column shows the relation between the US and the Swiss figures.
Source: AUTM (2002); BfS (2001); Vock and Jola (2002). The AUTM survey includes 190 US and Canadian organisations (universities and research organisations).

At first sight, the significantly lower relation of input than of output may support the hypothesis that technology transfer is more active in the United States than in Switzerland. However, this needs to be qualified. As noted above, the figure for invention disclosures in Switzerland is strongly underestimated; the interpretation of the number of patent applications as an output indicator is difficult owing to the different application strategies of TTOs (some select before application, others after); the lower number of patent grants is not surprising considering the age of the TTOs and their young patent portfolios.

Table 4. Comparison of some indicators between the Netherlands and Switzerland

Per thousand full-time equivalents

	Netherlands	Switzerland
Patent portfolio/R&D personal	41.4	98.3
Confidentiality agreements/R&D personnel	40.9	16.9
Patent applications/R&D personnel	11.0	14.2
Patent grants/R&D personnel	6.3	6.4

Note: In analogy to the Dutch study, data for higher education institutions were used for Switzerland. The number of R&D personnel in the disciplines "natural sciences, medicine, technical sciences" is taken as denominator (9 300 person years).
Source: MERIT (2002); Vock et Jola (2002).

The comparison between the Netherlands and Switzerland confirms the hypothesis that the patent portfolio of Swiss higher education institutions is quite large, when the comparable age structure of the TTOs is taken into account. Swiss and Dutch universities show a similar propensity to patent.

Conclusion

This chapter has described technology transfer in Swiss universities as operating in a heterogeneous legal and institutional environment and yielding good results. What superficially

appears as a contradiction is merely proof that technology transfer can work without the need for a centralised and uniform system. The Swiss experience shows that there are different approaches to successful technology transfer and that technology transfer managers can deal easily and pragmatically with historically developed structures. If not a uniform, straightforward ownership regulation, what is it then, that might explain the relative success of Swiss university technology transfer? The discussions with experts point to some soft factors such as the high motivation of the transfer personnel, close ties to academia as well as the lack of unnecessary and detrimental political interference.

Furthermore, the analysis has shown that technology transfer and the relevant legal environment lack policy priority both in higher education institutions and the federal state. For universities, technology transfer is a supporting activity and not a prime objective. The legal framework governing technology transfer is deemed to be acceptable, since changes are not on the political agenda for innovation policy.

If technology transfer moves up the political agenda, two observations should be kept in mind. First, the establishment of successful technology transfer takes time; it cannot take place overnight by changing ownership rules or investing huge amounts of money. Second, the most effective leverage for enhancing technology transfer is within the higher education institutions themselves. Internal structures, procedures, priorities and the university culture have to be adapted to internalise a real commitment to technology transfer. Appropriate incentive structures, regulations and adequate resources are supportive, but not of prime importance. In the same spirit, there is some room for improvement. Besides fostering a commitment to technology transfer within individual institutions, resources spent on technology transfer should be increased and better pooled to exploit economies of scale owing to the need for a certain critical mass for successful operation. Ownership rules for IP could gain in clarity with improved regulation, as is now proposed for the federal institutes of technology. Further, appropriate regulation of investment in firms for the purpose of technology transfer as well as rules for conflict of interests might also help.

As a last observation, this chapter has shown the difficulty of assessing the performance of technology transfer. Up to the present, there is no consensus on how to describe productivity. To compound matters, there is no single role model for technology transfer.

NOTES

1. The author gratefully acknowledges comments and assistance of the editors of this volume as well as H. Reutimann, U. Hinrichs, C. Jola and M. Streit.

2. In 2002, CEST participated in the OECD exercise to survey the patent and licensing activities of PROs (Vock et Jola, 2002) and also analysed ownership rules for intellectual property arising from publicly funded research (publication forthcoming).

3. The analysis was performed by CEST and can be accessed at www.cest.ch. A written publication is forthcoming.

4. The goals and proposed measures (legal changes, credit requests, etc.) of the Swiss government concerning tertiary education, research and technology (ERT) are described in a message to parliament covering a period of four years. For the period 2000-03, the document (Bundesrat, 1998) was issued in 1998 and discussed in parliament in 1999. The ERT-message covering 2004-07 (Bundesrat, 2002b) was issued in November 2002 and will be discussed in 2003 in parliament.

5. Of course, the link between research and commercialisation is influenced by many factors such as the disciplinary orientation of the research or the type of research (basic, oriented, applied research as well as development).

6. The bibliometric analysis by CEST includes the creation of a Champions League, a set of around 1 000 top-performing research organisations in the world. The Swiss higher education institutions show up disproportionately in this Champions League.

7. Thus, the table only includes organisations that provided data for all the three questions.

8. TTOs describe the objectives of technology transfer differently, but the following are frequently mentioned: *i)* facilitate the commercialisation of university discoveries for the public good; ii) reward, retain and recruit faculty and students; *iii)* forge closer ties to industry; *iv)* promote economic growth; and *v)* generate income. The objectives of the TTO of the University of Pennsylvania have been taken as an example. See: www.finance.upenn.edu/ctt/

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