Turning Science into Business

PATENTING AND LICENSING AT PUBLIC RESEARCH ORGANISATIONS

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EXECUTIVE SUMMARY

Introduction

Protection of intellectual property by public research organisations is increasing…

Intellectual property (IP) rights – of which patents, industrial designs, copyrights and trademarks are among the most widespread – reward investment in R&D and innovation by granting inventors and creators market power over competitors. Over the past decade in many OECD countries, universities, national laboratories and other research organisations receiving significant public research funds (hereafter referred to as "public research organisations – PROs") have become more aware of the value of their intellectual property. In large part, this awareness reflects the recognition by governments that, in some cases, placing the outputs of publicly funded research in the public domain is not sufficient to generate social and economic benefits from research.

…driven by legislative reforms but also by closer interaction with industry…

This awareness and demands to generate more economic benefits from public support to R&D have focused policy makers' attention on the laws and rules governing the ownership and exploitation of IP at PROs. In 1980 the Bayh-Dole Act in the United States gave university contractors of federal research the right to take out patents on inventions and license them to firms. Although patenting at US universities was occurring before 1980, it has since increased sharply. Between 1993 and 2000, US universities were granted some 20 000 patents. Over that period, some of these academic patents had generated millions of dollars in licensing revenue and have spurred the creation of over 3 000 new companies, according to the Association of University Technology Managers. Consequently, in other OECD countries and beyond, the Bayh-Dole Act has been widely viewed as a catalyst for increasing the social and economic benefits from public research funding.

…against a background of a strengthening of IPRs in the knowledge-based economies.

PROs have also been encouraged to protect their academic inventions and creative works by a general strengthening and broadening of intellectual property protection to new areas such as databases, genetic inventions, software or new materials that are closer to basic research. The results of publicly financed research have thus become more valuable to the research community and to firms. The rise of universities and new biotechnology firms as sources of commercially valuable know-how for the pharmaceutical and agricultural sectors illustrates this point.

This is creating opportunities for both governments and PROs.

For governments, granting PROs rights to IP generated with public funds can lead to better use of research results that might otherwise remain unexploited as well as to the creation of academic spin-offs or start-ups that create employment. For PROs the benefits may include increased licensing and royalty revenues, more contract research and greater cross-fertilisation between entrepreneurial faculty and industry. Equally important, however, are the intangible benefits to an institution's reputation and to the quality of its research that closer interaction with the private sector can generate.

A more active IP stance by PROs, however, raises a number of policy issues.

A more active IP stance at PROs, however, raises a number of policy issues about the costs of these activities and their impact on PRO missions. Does a more strategic IP policy: *i)* raise significant funds from licensing; *ii)* limit access to publicly funded research results; *iii)* affect the cost and efficiency of research; *iv)* reorient research towards more lucrative fields; and *v)* lead to conflicts of interests? As such questions are raised, many governments are trying to strike a balance between the research and commercial missions of PROs. In some OECD countries, observers point to a backlash against the commercialisation of public-sector research, fuelled by a perception that PROs have become overly influenced by market objectives and that the public interest requires safeguards against potential excesses.

The OECD Survey of Patenting and Licensing and Case Studies in IP Management at PROs

The lack of empirical evidence has clouded the policy debate.

To clarify the debate and to help countries address some of these issues, the OECD's Committee for Scientific and Technological Policy (CSTP) asked its Working Group on Innovation and Technology Policy (TIP) collect empirical evidence on the amount of patenting and licensing activity at PROs in OECD countries as well as information on the legal and regulatory frameworks that govern IP at PROs.

The OECD survey and case studies provide new information…

Few OECD countries, however, with the exception of Australia, Canada, the United States and the United Kingdom, regularly collect data on IP activity in the public research sector. Consequently, in 2001 the OECD launched the first international survey of patenting and licensing at PROs. A series of country case studies in IP management at PROs complement the survey by providing the "policy stories" behind the figures. This publication presents the findings of the survey and case studies.

…but the results should be viewed as an experiment.

The results of the OECD survey should be viewed as an experiment, albeit a revealing one that should be repeated. The data refer to patents assigned to PROs. In many countries, universities either do not automatically retain title or cede title to the inventors or the firms that sponsor the research. Therefore, the data on institutionally owned patents may understate the total amount of PRO patenting. The data also do not allow for full comparability across countries. Responses to variables such as full-time equivalent staff or research expenditures at PROs were submitted by only a few countries. This limits the ability to normalise responses using a common denominator. The data also cover patenting and licensing activity for the last calendar or fiscal year (2000 or 2001) and thus do not provide time-series information. Not all responding countries surveyed individual universities and non-university PROs; some provided only aggregate data, others provided disaggregated data only for universities or only for non-university PROs. Still, the survey has generated a substantial amount of useful information and raises new questions for further research.

Trends in intellectual property policies at public research organisations

Policies on ownership of IP are changing across OECD countries…

Across OECD countries, laws and policies governing the ownership of IP generated with public research funds are being re-examined with a view to encouraging ownership of inventions by the institution performing the research. In the European Union, there is concern that different national laws regarding the ownership and exploitation of IP from PROs, especially at universities, may create barriers to international collaborative research. Austria, Denmark, Germany and Norway have recently introduced new legislation to grant universities title to IP resulting from publicly funded research. In Finland, proposals are afoot that would, under certain conditions, give universities title to inventions. In Japan and Korea, recent reforms in funding regulations have given universities more control over the IP generated by their researchers. These policy trends echo the landmark US Bayh-Dole Act of 1980.

…to promote institutional ownership of IP.

However, whereas the Bayh-Dole Act modified the IP rules for federally funded research in the United States, most legislative moves in European Union countries have focused on changing employment laws so that university professors are no longer exempted from legislation that gives employers the IP generated by employees. A rationale common to both types of reforms is that ownership by institutions, as opposed to title by individual researchers, provides greater legal certainty for firms interested in exploiting research results, lowers transaction costs for partners and encourages more formal and efficient channels for knowledge and technology transfer.

IP policies are not well disseminated at PROs, including among students.

Despite changes in national legal frameworks, policies at the institutional level do not appear well disseminated among faculty and researchers at PROs. Similarly, rules on ownership of IP by students and other non-faculty at university-based PROs are either lacking or unclear in several countries. In addition, policies on ownership of non-patented IP, including copyrightable works, such as software or databases, are not well established or diffused at PROs in a number of OECD countries.

Most reforms focus on ownership but lack of incentives remains a problem.

Much of the focus of the reforms to legal frameworks has been on the issue of transferring ownership of IP to the performing institution. However, in several countries where PROs have owned the IP, patenting activity by institutions has nevertheless been weak. Part of the reason is that PROs have not had sufficient incentives, beyond legal requirements or institutional policies, to disclose, protect and actively commercialise IP.

Non-IP related rules can be a barrier.

In many OECD countries, non-IP related laws and regulations such as public-sector pay scales that make it difficult for PROs to recruit qualified technology transfer personnel can be a barrier to capacity building in technology transfer offices (TTOs). Fiscal rules that prevent PROs from receiving and retaining royalty income from licences – such as those recently lifted in the United Kingdom and Korea – can also weaken incentives for technology transfer.

Legislation is not the only policy option however. Funding guidelines can help…

The experience of OECD countries suggests that while legislation may sometimes be necessary to create the incentives for PROs to protect and commercialise IP, new laws are not the only action that can be taken. As an alternative, some governments have implemented "codes of practice" or general guidelines on IP ownership and management to foster greater transparency and coherence. Both the Canadian and Irish governments have sought to improve management of IP at PROs by reviewing or clarifying IP policies among the various performers of government research.

…and new legislation has raised awareness of IP at universities and other PROs.

Nevertheless, in countries that have implemented policies by legislative or other means, one of the main impacts has been to raise awareness of and support for technology transfer from universities and other PROs, especially within the administration of the organisations and among scientists/researchers and graduate students.

Greater coherence in national rules might induce cross-border harmonisation.

While greater compatibility – if not harmonisation – of the policies and practices of PROs within particular countries has the potential to improve technology transfer by reducing transaction costs, it can also help induce cross-border harmonisation and thus facilitate international collaborative research.

Technology transfer structures

Managing IPR requires institutional, financial and human resources.

A direct consequence of policies to grant PROs title to inventions and requirements for disclosure and exploitation has been the creation of TTOs or similar licensing offices to file patents and to enter into licensing agreements with third parties. Managing IPRs, however, requires institutional, financial and human resources.

Technology transfer offices are recent and generally have fewer than five full-time staff.

The OECD survey revealed a number of trends in the organisation and practice of technology transfer. There are several institutional models. Some TTOs have an arm's-length relationship to the PRO and may manage technology for several organisations. The majority, however, appear to be dedicated on-site institutions and integrated into the university or research institution. The TTOs are typically young structures; in Japan over 90% were established after 1990. Even in the United States their median age is 12 years. They are relatively small structures; in most cases, they have at most five staff (in full-time equivalent).

Countries are experimenting with regional or sector-based technology transfer offices

Denmark, Germany, Korea and the United Kingdom are experimenting with TTOs that are regional or sector-based according to field of research/technology and manage technology transfer activities for many PROs. Potential economies of scale might be realised by spreading fixed costs over a large number of inventions and perhaps exploiting the benefits of portfolio diversification. A potential drawback of regional approaches and "central broker" technology transfer models more generally is the difficulty of developing close working relationships with faculty/employees of individual PROs, relationships which are often valuable for stimulating invention disclosures, writing patent applications, and finding licensees.

The most important channel for licensing PRO patents is researcher contacts.

Indeed, the OECD survey shows the channels most often used by TTOs to seek licensees are informal relations and networks of researchers. This testifies to the importance of involving scientists in the further development and licensing of an invention. The networks or contacts of the TTO are also an important channel. Advertising or technology broker networks are used less frequently or not at all.

There is no "one size fits all" approach to technology transfer.

There are, however, are important differences among PROs that shape TTO structures and affect patenting and licensing strategies. Universities, fundamental research organisations, government labs and contract research organisations play different roles in innovation systems, generate different types of knowledge for different clients and therefore require different IP management processes. A contract research organisation such as IMEC in Belgium will differ in its approach to patenting and licensing from a basic research organisation, such as Germany's Max Planck Society. A university with research groups in different technological fields and a different type of staff (including students) may need yet another IP management strategy.

Governments are providing more support to academic patenting and licensing in many countries.

In line with legislative reforms to create incentives for IP management at PROs, governments in Denmark, Japan, and Germany are providing direct and indirect support, on a time-limited basis, to help universities and other PROs cover the costs associated with patenting and commercialising inventions. Indirect support takes the form of reduced patent application costs for universities as well as informational and awareness creation measures. Without leadership from senior university or research management, however, public support for IP activities at PROs is likely to have a limited impact – increasing the number of patents filed but not necessarily the transfer of technology.

International evidence of patenting activity by PROs

The size of patent portfolios is larger at non-university PROs.

The size of patent portfolios or the stock of currently active patents varies widely across and within OECD countries, depending on whether the PRO is a university or a national laboratory. Total active patents in portfolios ranged from 692 in Japan, 991 in the Netherlands, 1 184 in Switzerland to more than 5 000 in Germany (at non-university PROs only) and over 9 000 in Korea (both universities and non-university PROs). On average, individual TTOs manage between five and 50 patents. Here again, differences by type of PRO are apparent. In Italy only 18% of universities manage up to 50 patents whereas 80% of non-university PROs surveyed reported managing between ten and 50 patents. There are several explanations for differences in patent portfolio by type of PRO. For one, universities in several OECD countries have only recently either obtained the right to patent or established TTOs. Furthermore, non-university institutions, especially in European OECD countries, have had a longer tradition of protecting and commercialising IP.

New patents granted range from the low to high hundreds.

Total number of patents granted in the last year (2000 or 2001) ranged from several hundred in Germany (747) and Korea (832), to the low hundreds in Japan (163), Netherlands (167) and Switzerland (112).

PROs file less than ten new patent applications per institution but applications are likely to increase.

New patent applications per PRO ranged from an average of less than ten in almost half of the countries surveyed to several dozen. However, low patenting may also reflect PRO strategies: some apply for patents after a thorough examination and selection process while others may file for patents automatically each time an invention is disclosed. Public funding requirements that PROs protect and exploit the IP arising from research can also affect patent application rates. As several OECD countries have recently implemented new requirements for PROs, patenting applications are likely to increase in the near future.

Invention disclosures are indicative of potential patenting.

The number of "invention disclosures" – the document submitted by inventing scientists to their TTO – is another indication of the potential for new patents. The countries where PROs reported the greatest number of invention disclosures are the United States (16 286 at both universities and federal labs), Germany (948 at non-university PROs), Japan (489 at universities), Korea (418 at all PROs) and Switzerland (280 at all PROs) followed by Belgium (Flanders only) (230 at all PROs).

PRO patenting is not limited just to biotechnology and health fields…

While much of the increase in academic patenting has been attributed to the expansion of biotechnology, the OECD survey finds that even if patents in health and information technology predominate for some countries (Belgium, Germany, Netherlands and Switzerland), academic patenting is also significant in production, food and energy technologies. Patenting outcomes are likely to be associated with a country's R&D and industrial specialisation. In Korea for example, where IT is important in business value added, over 70% of universities declared having filed a patent in IT and electronics.

…and there is significant protection of IP by PROs in foreign jurisdictions.

TTOs may be small, but their approach to protecting PROs' IP seems to take a geographically broad view. Patents are filed first and foremost at national level, but almost all TTOs reported that they also filed abroad. PROs in Germany, the Netherlands and Switzerland were more likely (over 50% of institutions surveyed) to seek protection at European-wide level, in the United States and Japan than were PROs in Spain, Norway or Russia and Italian universities.

The IP activity of researchers has a greater influence on earnings than on careers.

While PROs are adapting human resources policies to give greater recognition of IP activity in recruitment and career advancement, licensing revenues provide strong incentives for researchers to explore the commercial applications of research. The survey finds that the effects are greater on researcher earnings than on career advancement.

Summary results of the OECD survey on patenting and licensing activities

		Patents					Licences			Start-ups and spin-offs
		Total patent stock	Patent grants		Patent applications		Issued in last year	Earning income	Gross income	Total number created in last year
			Number granted in last year	% total stock	Number filed in last year	% total stock			EUR (000)	
Australia (2000)	All	-	498	-	834	-	417	491	99 525	47
	Univ	-	219	-	586	-	234	-	79 834	32
	PRO	-	279	-	248	-	183	-	19 691	15
Belgium (Flanders) (2001)	All	506	57	11.3	121	23.9	46	4	240	15
	Univ	-	-	-	-	-	-	-	-	-
	PRO	-	-	-	-	-	-	-	-	-
Germany (2001)	All	-	-	-	-	-	-	-	-	-
	Univ	-	-	-	-	-	-	-	-	-
	PRO	5 404	747	13.8	1 058	19.6	555	1 188	46 468	37
Italy (2000)	All	-	64	-	190*	-	36*	84	-	36
	Univ	-	34	-	102*	-	27*	12	-	27
	PRO	-	30	-	88*	-	9*	72	-	9
Japan (2000)	All	682	163	23.9	567	83.1	89	324	1 397	6
	Univ	-	-	-	-	-	-	-	-	-
	PRO	-	-	-	-	-	-	-	-	-
Korea (2001)	All	9 391	1 018	10.8	1 692	18.0	247	132	3 822	56
	Univ	404	186	46.0	244	60.4	44	22	1 032	19
	PRO	8 987	832	9.3	1 448	16.1	203	110	2 790*	37
Netherlands (2000)	All	991	167	16.9	212	21.4	368	93	11 400	37
	Univ	394	64	16.2	111	28.2	250	-	-	27
	PROs	597	103	17.3	101	16.9	118	-	-	10
Norway (2001)	All	-	-	-	-	-	-	-	-	67
	Univ	-	-	-	-	-	-	-	2 000*	16
	PRO	114	28	24.6	43	37.7	22	39	7 700*	51
Spain (2001)	All	781	64	8.2	133	17.0	125	136	961	11
	Univ	-	-	-	-	-	-	-	-	-
	PRO	-	-	-	-	-	-	-	-	-
Switzerland (2001)	All	1 184	112	9.5	175	14.8	475	77	5 650	68
	Univ	914	59	6.5	132	14.4	200	61	2 800	56
	PRO	270	53	19.6	43	15.9	275	16	2 850	12
United States (2000)	All	-	5 103	-	8 294	-	-	-	-	-
	Univ	-	3 617	-	6 135	-	4 049	8 670	1 297 452	390
	PRO	-	1 486	-	2 159	-	3 007	484	69 600	-
Russia (2001)	All	-	349	-	171	-	206	8	1 375	15
	Univ	-	-	-	-	-	-	-	-	-
	PRO	-	-	-	-	-	-	-	-	-

Australia: Data from the *National Survey of Research Commercialisation*, Australian Research Council 2000. Gross income in USD.
Italy: number of patent applications and number of licences granted are estimates.
Korea: One licence reported is not included in total number of active licences and total gross income. Gross income in USD.
Netherlands: Gross income is an estimate.
United States: Total number of income earning licences for federal labs is probably understated, as data are collected as earning "running royalties" and licences can earn income in other ways. Gross income in USD.
Russia: total number of patent granted and patent applications are estimates.

Licensing strategies of public research organisations

Two-thirds of PROs negotiate less than ten licences per year…but many licences are for copyright and other non-patented IP.

The majority of PROs negotiate a very small number of licences (often less than ten) a year. One-third negotiate between 15 and 46 licences each year. Surprisingly, a large share of licence agreements in Italy, Japan, the Netherlands and Switzerland were concluded for patent-pending inventions or non-patented inventions (*e.g.* biological materials or know-how), as well as for copyrighted materials. The importance of non-patent licensing seems to support other evidence that PROs tend to license early-stage technologies requiring further development by firms.

Licensing revenue varies greatly across PROs and countries…

One of the most sought-after pieces of information is the amount of revenue that PROs generate from the licensing of intellectual property. There is enormous variation across OECD countries and even among PROs within a country. In absolute terms, US universities generated the largest amount of income from licences, over USD 1.2 billion followed by Germany at EUR 46.5 million (non-university PROs only). Per institution gross licensing income ranges from the thousands to the low millions: United States (USD 7.7 million); Germany (EUR 1.5 million); Korea (USD 537 000); Switzerland (EUR 269 000); and Japan (EUR 93 000).

…and is highly skewed, as a few licences generate most of the revenue.

Data on licensing revenue per licence reveals the skewed nature of income from technology transfer. While some PROs in the United States generate several million USD from licences, the average value of each licence in 2000 was USD 150 000. A large percentage of licences never generate any income and only a small percentage earn high income. Japan, which has fewer licences and less aggregate revenue, generated EUR 139 000 per licence. In Switzerland, the average revenue per licence is EUR 45 000. This shows that some licences are more valuable than others and that a high number of licences does not necessarily mean high revenue or *vice versa*.

The number of new spin-off companies created to commercialise inventions is small but the phenomenon is widespread…

In general, PROs prefer to license to existing companies but they may also license IP to a spin-off or start-up company. The number of spin-offs per TTO created in 2000/2001 is low, yet spin-off activity is widespread across OECD countries. In most cases, PROs create less than one spin-off or start-up a year, except in the United States where the average in 2000 was two per university PRO. Licensing and spin-offs are two sides of the same technology transfer coin, however. PROs often license their technology to a spin-off to retain greater control and access to the IP.

…and the numbers are influenced by PROs' licensing strategies.

In many ways, the number of spin-offs is influenced by the licensing strategies of PROs as well by the pool of entrepreneurial managers and access to seed capital. The field of technology also matters, and inventions arising in areas of non-core research may be spun off. Case-study research suggests that so-called "platform" inventions, those that may lead to a wide range of applications, are more likely to be licensed to spin-offs than to existing firms.

Small companies obtain slightly more licences than large ones and licensing overseas is common.

Evidence on licensing by firm size is inconclusive in the aggregate, but in several countries small firms appear to obtain more licences than larger ones. Non-university PROs tend to license to small firms (in Germany, Korea and Switzerland). In Belgium (Flanders) and Japan (universities) most licensees are large firms. Some 80% of Swiss PRO licensees are foreign firms. Similarly, Dutch universities are more likely to license abroad than at home, possibly owing to the international nature of Dutch research as well as the limited national market for IP.

Small firms do not obtain more exclusive licences than large firms

One of the concerns of the scientific community and policy makers is that the exclusive licensing of patents to single firms will limit the diffusion of knowledge generated with public funds. Yet firms, especially small firms and academic start-ups/spin-offs for which IP constitutes a main asset, generally demand exclusive licences in order to offset the risks involved in developing academic inventions further. Contrary to expectations that start-up firms are especially reliant on exclusive licences, data from the OECD survey show that small firms (fewer than 500 employees) do not obtain exclusive licences more frequently than large firms.

Licences negotiated by PROs often contain clauses that protect public interests.

About half of the PROs include clauses in their agreements which require the licensee to make good-faith efforts to exploit the invention. Licences often include some form of limited exclusivity (*e.g.* by territory or field) so that the technology may be used by more than one firm. Less common but still important are clauses in licensing agreements that grant the PRO reach-through royalties or rights of first refusal on future inventions. There is, however, a good deal of variation among countries as to how common such clauses are.

Fears of crippling legal costs for PROs seem unsubstantiated.

Despite the upswing in PRO IP activities, they have not to date been heavily involved in infringement litigation. In fact, PROs are slightly more likely to sue a third party for infringement than to be sued.

Conclusions

Legal action can stimulate the "transfer" of publicly funded research.

In most OECD countries some sort of legal action has been necessary to stimulate the "transfer" of publicly funded research, although there is no single template for how such legislation should look like. Differences in national contexts may call for different solutions, even if most OECD countries are moving in the same direction. Harmonisation – or at least compatibility – of national rules regarding IPR at PROs may also facilitate international collaborative research by reducing transaction costs.

But laws are not sufficient; a change in mindset is needed.

Legal instruments are important but not enough: in many countries a change in the culture and mindset of researchers is also needed. TTOs also need to be free to hire high-quality technology transfer specialists with industry experience, and governments may need to modify legal regulations to facilitate this.

Countries are still learning about the costs and benefits of various types of TTOs.

There is no one model for a technology transfer office. Individual countries and organisations are still learning about the costs and benefits of various approaches. Several countries are experimenting with regional or sectoral TTOs, recognising that many individual PROs do not have the scale of research necessary for local TTOs.

Close relationships with inventors and labs are necessary for technology transfer.

However, to the extent that close relationships with inventors and labs are necessary to the technology transfer process, the geographic proximity offered by on-campus TTOs may be important. Since few TTOs are likely to generate positive net revenues, at least in their early years, some sort of cross subsidisation by PROs might be desirable.

Licensing safeguards can help PROs balance research and commercial goals.

PROs are best suited to negotiate the terms of licensing agreements with firms. However, policy safeguards such as those recommended by funding agencies can help balance the research and commercial goals of PROs. Individual PROs can set their own judicious guidelines. Finally, the licensing strategies of PROs can be used to maintain access to IP so that it is not lost should, for example, a "spin-off" company fail.

Regular surveys would benefit PROs and policy makers.

Regular surveys of patenting and licensing activities – undertaken by national governments, multilaterally, or by PROs themselves – are needed to provide input to policy makers but also to help PROs benchmark performance and learn from one another. It is important to remember that for many institutions, reporting of IP activities is new. The US experience shows that the ability of PROs to respond to such surveys improves over time.

Although the OECD project was limited to assessing IP rules at PROs and collecting empirical and anecdotal evidence of patenting and licensing at PROs in OECD countries, it has resulted in substantial insight into the increase in IP activity at PROs, and the challenges facing research administrators and policy makers.

Main Policy Recommendations

I. Make national IP policies more coherent

Policies for IP ownership should be coherent across universities, other PROs and funding agencies:

In many OECD countries, legislative action has been taken to ensure that both universities and non-university PROs have a common basis for allocating ownership of IP to institutions (or contracting parties). This helps reduce transaction costs, increases transparency and facilitates exploitation of IP by third parties.

Government funding agencies may also foster coherence through non-legislative means such as "codes of practice" or government policy guidelines which clarify ownership and exploitation requirements for universities and other PROs.

II. Encourage the development and implementation of IP policies at the institution level

Policies on the ownership of patented inventions as well as copyrightable works such as software should be better disseminated among faculty, research staff and students

Regulations and policies requiring research staff to disclose and report inventions allow for greater oversight by universities and PROs. National funding laws or regulations can promote this by requiring PROs to report IP to funding agencies. But requirements should be backed by control mechanisms and incentives.

Design and disseminate conflict of interest rules

Universities and other PROs should develop clear guidelines on conflict of interests. Governmental funding agencies can help set the standard by promoting national guidelines.

Permit exclusive licensing while protecting public research interests

Universities and other PROs should be free to negotiate exclusive licences but should design guidelines to ensure that IP that is not commercialised by licensees is not lost. For example, minimum royalty and milestone requirements could be used to create pressures to cancel the exclusive licence if the licensee fails to exploit the IP. Field-of-use restrictions on exclusive licences can also be used to ensure that the IP is made available for future research as well as other firms.

Designing licence agreements to share liability and responsibility for protecting against infringement with licensee firms could help reduce the potential costs of litigation to the PROs.

III. Enhance IP management capacity at PROs

IP management must become an integral part of research management

Presidents and directors of universities and PROs should make IP management part of their research management plans. One way to accomplish this is by having heads of technology transfer operations report directly to university presidents and/or research directors.

PROs should have greater freedom and resources for hiring and training technology transfer managers

The success of PROs in commercialising IP depends strongly on human resources, in particular technology transfer professionals with both a scientific and industrial background. In many countries, rigid public pay regulations limit PROs from hiring professional technology transfer staff. Relaxing such regulations should be encouraged.

Universities should also invest in specialised educational programmes to train engineers, scientists and lawyers in technology transfer. This can build awareness of IP among future science graduates as well create a pool of talent from which TTOs can develop their skills base.

Government support to TTOs should be limited

Insofar as the goal of TTOs is to facilitate the commercialisation of publicly funded research where social returns might exceed private returns, there is an argument for subsidising the creation of technology transfer structures, at least in the early stages. Support should be limited and focused on building greater *incentives* for IP management rather than simply reducing operating costs. In some cases, direct government subsidies to TTOs may be incompatible with national and supra-national legislation on government aid as well as with competition laws.

National patent offices should be mobilised to diffuse information on IP management to universities

In some OECD countries, national Patent Offices are providing educational and internet-based services to help universities become more aware of IP. Such good practices should be emulated in other countries.

IV. Improve data collection and share good practices

Governments and PROs should promote better monitoring of IP activity

Requirements by government funding agencies for invention disclosures and reporting by PROs can create incentives for greater data collection.

Associations of universities or research organisations can help PROs to regularly collect and share information on IP activity, including good practices.