1. Introduction

Knowledge dissemination has always been a key component of the university mission. A range of values underpin this. First, and perhaps most importantly, knowledge dissemination has high social value. Knowledge is a public good that is non-rivalrous and non-excludable.¹ Knowledge also has academic value. The quest for new knowledge and knowledge dissemination are central to the norms of science.² It also has practical value. Dissemination of knowledge in the form of high quality academic publications and conference proceedings is a measure of success, both for the university and for the individual researcher. Knowledge generation and transfer is what we, as academics, do. It is our core business.

Perhaps the one key value that is missing from this equation is commercial value. Traditional forms of knowledge dissemination do not have direct

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commercial value, although this may ultimately eventuate as the result of uptake of knowledge from the public domain by industry. However, it is difficult if not impossible to predict what public knowledge will be taken up by industry in advance.\textsuperscript{3} As Dasgupta and David point out:

The economic value of basic science is difficult to forecast, or even to gauge in retrospect. Economic payoffs entailed by scientific discoveries may come quickly, but more often are not realised for a long time. Since basic research occurs on the frontiers of knowledge, its outcomes are highly uncertain.\textsuperscript{4}

Over time, the need to capture the more immediate commercial value of knowledge created in universities has increasingly been recognised by universities themselves, by governments and funding agencies, and by industry.\textsuperscript{5} Government funding, tax relief and propertisation of knowledge are some of the possible mechanisms that have been suggested for encouraging the commercial dissemination of university knowledge to industry.\textsuperscript{6} The favoured model focuses very much on the propertisation of knowledge through linear path from knowledge creation to disclosure to patenting to licensing or the creation of a spin off company to commercially develop the research.\textsuperscript{7} This is particularly the case in biotechnology, where moves to commercialise university knowledge in the late 20\textsuperscript{th} century coincided with relaxation of the thresholds for patenting of inventions relating to gene sequences and other research tools, many of which were created in the university environment.


\textsuperscript{4} Dasgupta & David, \textit{supra} note 1 at 489.

\textsuperscript{5} Note, however, the argument that U.S. universities have always had a much closer relationship with industry than other industrialised countries. See David C. Mowery \textit{et al.}, \textit{Ivory Tower and Industrial Innovation: University-Industry Technology Transfer Before and After the Bayh-Dole Act In the United States} (Stanford, Cal.: Stanford Business Books, 2004) at 9-13 [Mowery \textit{et al.}].

\textsuperscript{6} Dasgupta & David, \textit{supra} note 1 at 495-497.

\textsuperscript{7} Australia, Department of Education, Science and Training, John Howard, \textit{The Emerging Business of Knowledge Transfer: Creating Value from Intellectual Products and Services.} (Canberra: Commonwealth of Australia, 2005) [Howard].
These events led to a flood of patent applications by universities and other public sector organizations in this field.  

The primary justification for adding commercial value as a component of the university mission relating to the dissemination of knowledge is that it promotes technological development for the benefit of society as a whole. Technological development is seen as being good for society from both the economic and the social perspective. This policy of merging of basic research and applied technology, particularly in the area of biotechnology, is common throughout the industrialised world.

It is now over a quarter of a century since this drive to commercialise university knowledge commenced in earnest in many industrialised nations (and even longer in the U.S.). It seems appropriate, then, to engage in an analysis of the outcomes of this commercialisation strategy to date and to make an assessment of the value of this and other strategies for achieving optimal dissemination of university knowledge. In biotechnology, there is no doubt that the commercialisation drive and relaxation of patenting standards occurred in parallel with a surge in the number of biotechnology firms entering the field. However, the causative links between these events continue to be debated, as do their benefits and costs in terms of dissemination of knowledge and innovation.

In this paper, I explore some of the implications of the movement to attach commercial value to university knowledge dissemination. I then consider some alternative mechanisms for knowledge dissemination. First, I consider collaborative mechanisms for enhancing public benefit within

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10 See generally Mowery et al., supra note 5.


12 See generally supra note 8 and also the International Expert Group Report, ibid.
the core commercial value paradigm that pivots around the linear model of discovery, disclosure, patenting, licensing and assignment of patent rights. Then, I look at other mechanisms for commercial dissemination outside the linear model. Finally, I consider more open mechanisms for dissemination, where the expectation is still that commercial value will eventuate, but in the much longer term.

2. Benefits and costs of commercialisation of knowledge

A range of practical benefits may be associated with the drive to realise the commercial value of knowledge. It benefits governments and funding agencies because it provides return on investment, potentially allowing them to reduce their own monetary contribution. It provides universities with an alternative means for raising income that can be fed back into further research as well as a certain level of prestige associated with successful technology transfer and independent revenue raising. It provides researchers with additional income for further research and for personal purposes and, in some instances, to participate in the process of commercially developing their knowledge. While the time has probably not yet come when successful commercialisation is a measure of academic excellence, there are ongoing calls for this to occur. Commercial dissemination of university knowledge provides industry with the opportunity to own or to license that knowledge and to exclude competitors, thereby encouraging commercial development. Opportunities for commercial development are also likely to encourage university researchers to target their research more to the needs of industry. Finally, commercial dissemination provides society with the increased likelihood that new products and services will emerge from the commercial development of university-generated knowledge.

But putting commercial value on knowledge is not cost-free. In this part of the paper, five distinct problems that could arise as a result of the drive to commercialise are identified. Then, Part 3 assesses and evaluates the evi-

13 This model is well articulated in Donald S. Siegel et al., “Toward a Model of the Effective Transfer of Scientific Knowledge from Academicians to Practitioners: Qualitative Evidence from Commercialization of University Technologies” (2004) 21 Journal of Engineering Technology Management 115. See particularly their Figure 1.
dence as to the extent to which these problems are arising as a consequence of the application of the linear model of commercialisation by universities.

The first problem is that significant funds have to be allocated by universities for setting up the infrastructure for capturing the commercial value of transferred knowledge. Technology transfer offices have been established in most universities in industrialised countries to facilitate the transfer of patented technology and to carry out other functions. They take a number of forms, ranging from single individuals sitting in the university’s main research office through to companies with multiple personnel. Success is not guaranteed, and there will be instances where the infrastructure costs far outweigh the returns. I refer to this as the return on investment problem.

The commercialisation of knowledge also brings together an unusual collection of individuals: university administrators, researchers and industry. Each of these groups is likely to bring quite different interests and experience to the bargaining table. University administrators are likely to focus on cost recovery whereas the driver for industry is product development. Administrators and researchers are faced with unique problems of learning negotiation skills and putting financial value on their research. While they are given the direction to commercialise from government and funding agencies, they are provided with little guidance as to how to go about this. Although most funding agencies provide guidelines to funding recipients on the commercialisation of knowledge generated using public funding, it is perhaps surprising that they seem to be content to leave the practical aspects of the knowledge dissemination process to others. While there are “march in” rights in U.S. legislation, these provisions are unusual, and in any case they are rarely, if ever, used in that jurisdiction. The Australian Law Reform Commission [ALRC] has noted that Australian funding agencies tend to take a “hands off approach to commercial development of research results,”14 but nevertheless rejected the notion that this should be changed through the introduction of march-in rights.15 The ALRC concluded that research organisations are in a better position to commercialise knowledge than funding agencies, even those that lack commercial expertise or funding.16 For indus-

try, individual businesses are faced with having to expend time and money in capturing university knowledge, which may previously have been freely available. I refer to this as the *clash of cultures problem*.

The propertisation of knowledge also increases the likelihood for industry (and, indeed, for universities themselves) of impinging on other people’s property, requiring further licensing and heightening the risk of litigation. The concerns are that broad patents over foundational technology and patent thickets can cause hold ups and anticommons effects. Hold ups occur when the owner of a broad patent over foundational technology refuses to deal with a developer of downstream technology. An anticommons can arise when there are numerous overlapping property rights and when reach – through terms in licence agreements lead to licence and royalty stacking. As universities are the main generators of upstream technologies, they have the capacity to contribute significantly to hold up and anticommons risks. For society, although new products and services might be more likely to eventuate from commercial dissemination of university knowledge, they might be prohibitively expensive when compared with other, more traditionally developed products and services, because licence fees and other charges have to be paid at each step in what is likely to be a multi-step process from dissemination of knowledge through to the delivery of products in the marketplace. Innovation and competition within the market place could both be decreased if knowledge is propertised, potentially affecting product choice and quality as well as cost. I refer to these issues collectively as the *innovation and access problem*.

For university researchers, the commercial value of their knowledge may never be realised, despite the associated costs. Because some research effort will redirected from more basic to more commercially oriented projects, more traditional forms of knowledge transfer may be deterred. Time and effort may need to be expended in attempting to exploit the economic value of the knowledge, reducing further the time that can be allocated to research. Commercialisation is also likely play a role in discouraging the dissemination of knowledge into the public domain, because of the need to delay the release of codified knowledge in scholarly publications to protect the novelty of patentable inventions. But the dissemination of tacit knowledge

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and the sharing of materials may also be deterred to protect the commercial head start.\(^{18}\) The broader social value attached to curiosity-driven science must also be recognised. Redirection of the research effort towards more commercially oriented projects could have social implications if it reduces the likelihood of serendipitous research findings that could benefit society as a whole. I refer to this as the *researcher motivation problem*.

Given that the primary goal of knowledge dissemination is the public benefit and that there are significant costs as well as benefits of following the commercialisation route, the task at hand is not a trivial exercise. It would be naïve to assume that the pursuit of a commercialisation imperative will always be in harmony with other social objectives. There will be times when the public interest is better served by other dissemination strategies. Different strategies will be needed for different research sectors. I refer to this as the *best fit problem*.

### 3. Putting commercial value on university research – the linear model

Putting commercial value on knowledge requires the creation of knowledge assets that can be defined, valued and exchanged in market-based transactions.\(^{19}\) Intellectual property rights are good examples of knowledge assets because they provide a clear legal mechanism for the propertisation of knowledge. In biotechnology, in particular, universities have wholeheartedly adopted propertisation for the dissemination of knowledge, using the linear strategy which focuses on technology transfer by licensing or assignment.

There has been much debate in the U.S.-based literature as to whether or not the propensity for universities to patent is tied to the passage of the *Bayh Dole Act* in 1980.\(^{20}\) Irrespective of the outcome of this debate, the fact is that since around that time universities and other public research organizations have been some of the most active patenters in biotechnology in that jurisdiction in particular.\(^{21}\) No doubt judicial decisions clarifying the patent-

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19 Howard, *supra* note 7 at 5.
20 Mowery *et al.*, in particular, are sceptical about the role of the *Bayh Dole Act*. *Supra* note 5. See also Thursby & Thursby, *supra* note 2 at 206.
ability of inventions derived from natural sources also played an important role in encouraging filing of biotech patents. The argument that is often put is that without patents university inventions would not be commercialised.\footnote{Mark A. Lemley, “Are Universities Patent Trolls?” (2008) 18 Fordham Intellectual Property Media and Entertainment Law Journal 611 at 621 [Lemley].} For better or for worse, both patenting and formalised technology transfer have become mainstream strategies of disseminating the knowledge resulting from biotechnology research carried out in universities, in addition to the more traditional forms of publication in peer-reviewed journals.

Clearly, there can be detrimental social consequences associated with the linear model particularly because it can prevent or delay the entry of that knowledge into the public domain. It is trite that if some individuals are provided with exclusive proprietary rights over tangible assets like land and natural resources that would otherwise be in the public domain, then others are deprived of the use of those assets. Knowledge is a somewhat different commodity, however, because it is generated \textit{de novo} and has not entered into the public domain. As such, propertisation of knowledge does not remove it from the public domain in the same way as fencing off land.

While it could be argued that the mere fact that university knowledge is generated using public funds requires that it should enter the public domain with all due haste, the public benefits associated with the commercialisation of knowledge could justify some delay. The issues that need to be explored further are the extent to which the benefits associated with this linear model actually outweigh the associated costs and whether, on balance, other strategies might be more appropriate in some circumstances. Given that there is now considerable experience with the linear model, a body of evidence is emerging which can be used to test the assumptions upon which it is based. In this section, I consider the five problems with commercialisation that I identified above in the context of the linear model for the commercial dissemination of university knowledge. Evidence is emerging that these problems are, in some circumstances, causing genuine impediments to the dissemination of university knowledge, which suggests that we need to look more deeply into the broad applicability of this model.
3.1 The return on investment problem

Despite the enthusiastic adoption of the linear strategy for commercial dissemination of knowledge, the evidence suggests that licensing revenue rarely covers the cost of administration. While some U.S. universities have flourished under the linear model, this is not the norm. In Australia, a report commissioned by the Australian Research Council [ARC] in 2003 on the return on investment from ARC-funded research concludes that there was a 10% social rate of return based on building of the basic knowledge stock but only a 3% return from generation of commercialisable intellectual property. The report notes further that commercialisation returns to universities are relatively small when compared with money spent on research. Ann Monotti and Sam Ricketson also comment that the increased propensity to patent in the public sector has not been matched by increased output, even in the U.S. with the bulk of technology transfer revenue coming from a few successful inventions, the “big hits” or “blockbusters.”

Bearing these arguments in mind, it is somewhat difficult to see what motivates universities to continue with this strategy. Perhaps the most compelling argument is to do with prestige: universities need to be seen to be playing the commercialisation game, even if they are not in fact recouping the costs of being a player.

3.2 The clash of cultures problem

Patents do not fulfil the function of encouraging commercial development of inventions if they languish unexploited in technology transfer office filing cabinets or if they are used primarily as a mechanism for generating revenues from enforcement actions by non-manufacturing entities (the so-called troll problem). There are various reports in the literature of complaints by

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23 Mowery et al., supra note 5 at 190. See also Thursby & Thursby, supra note 2 at 209.
25 Ibid. at 46.
27 Ibid. See also Thursby & Thursby, supra note 2 at 209.
28 Lemley, supra note 22.
potential industry partners about universities overvaluing their technology. Mark Lemley, for example, refers to a conversation with an industry participant, who described universities as “crack addicts” driven by “small minded tech-transfer offices” addicted to patent royalties. Hertzfeld et al. also refer to value and income from intellectual property as being a major issue in the relationships between universities and industry, noting that “special [technology transfer] offices within universities to handle these negotiations has, from an industry viewpoint, created additional tension ...”

In my own research involving interviews with researchers, technology transfer officers and participants in the Australian biotechnology industry, one of the major problems that was consistently referenced was differing expectations with regard to the value of university patents. It was generally recognised by respondents that in the past Australian research institution researchers tended to under-value their intellectual property, giving it away too much, too soon, for too little. One technology transfer officer gave an example of an assignment of intellectual property rights in return for a research assistant’s salary for three years. However, a number of respondents reported that attitudes may now have swung too far the other way, with some researchers over-valuing their intellectual property. As one industry respondent noted:

Some people clearly over value. Because it has taken 10 years and several million dollars to develop their intellectual property they want around AU$5 million upfront. This is ridiculous when all they

29 Ibid. at 615
have is a provisional that has never been tested and the patent is not granted yet.  

In the end, what universities get will be determined by what the market will bear. If they do have an unrealistic view of the value of their technology, then potential industry partners will walk away.

3.3 The innovation and access problem

The main argument for the linear model seems to be that it encourages investment in downstream product development because it provides industry partners with the ability to exclude competitors. If it really is the case that this capacity to exclude others is the crucial incentive for industry partners then it follows that university patents should always be licensed exclusively. But exclusive licensing of university inventions is often criticised because it locks up knowledge that would be better disseminated more broadly. This problem is particularly acute if licensees enter into licences simply to block others from developing technology, with no intention to develop it themselves. Licence terms including requirements to pay upfront and milestone fees, performance clauses and reversionary rights can solve this so-called shelving problem, which can also occur when a licensee commences but then ceases development of university knowledge, for whatever reason. Point 2 of a White Paper on Nine Points to Consider in Licensing of University Technology, recently formulated by technology transfer administrators at some of the leading U.S. universities, reminds technology transfer offices to structure exclusive licences in a manner that encourages technology development and use.

32 Ibid. at 136.


35 Point Two goes on to recommend on the following matters: consideration of whether the licence needs to extend to all fields of use, setting performance milestones, requiring mandatory sub-licensing for unmet market or public
Non-exclusive licensing is being endorsed as the appropriate strategy for the transfer of genetic research tools at the highest policy levels in the U.S. and internationally.\textsuperscript{36} Yet it could be argued that non-exclusive licensing of research tools has no benefit from the perspective of encouraging knowledge dissemination but is purely done for revenue raising purposes. For example, non-exclusive licensing of the patents associated with recombinant DNA technology generated a great deal of revenue for Stanford University and the University of California, but it did not necessarily add to the licensees’ ability to innovate. Much depends on whether, aside from the disclosure in the patent application, the technology would have been kept secret. If the entirety of the information has already been or is intended to be put into the public domain through other forms of publication (e.g., in peer-reviewed journals) then, effectively, licensing amounts to little more than a tax.\textsuperscript{37}

Evidence from empirical research in the biomedical sector involving questionnaires and interviews with university researchers suggests that patents rarely impede their research programs.\textsuperscript{38} Also, the biomedical industry as a whole seems to be finding ways of working around perceived problems associated with university patents, particularly the risks that broad patents and patent thickets will deter downstream innovation.\textsuperscript{39} It seems that, for health needs, consideration of broad non-exclusive licensing for genomic and proteomic inventions. \textit{Ibid.}


\textsuperscript{37} Mowery \textit{et al.}, \textit{supra} note 5 at 159.

\textsuperscript{38} Walsh, Cho & Cohen, \textit{supra} note 18; Nicol & Nielsen, \textit{supra} note 31.

the most part, biomedical patents, particularly research tool patents, tend to be licensed widely, and users engage in a number of strategies to ensure that their research and development programs can continue, including licensing-in, inventing around, litigating to challenge patent validity, moving offshore, or simply ignoring the patents that would otherwise block their research. Despite this optimistic picture, participants in the biomedical industry do have to navigate through the increasingly complex patent landscape, and the associated challenges should not be trivialised. Even more worryingly, innovation blockages seem to be encountered more often in sectors other than biomedicine, particularly agricultural biotechnology.\footnote{G. Graff & D. Zilberman, “Towards an Intellectual Property Clearinghouse for Ag-Biotechnology” (2001) 3 IP Strategy Today 1.}

3.4 The researcher motivation problem
There are frequent reports in the literature about the difficulties in getting university researchers to engage in the technology transfer process.\footnote{Richard Jensen, Jerry G. Thursby & Marie C. Thursby, \textit{The Disclosure and Licensing of University Inventions}, NBER Working Paper # W9734 (Cambridge, Mass.: National Bureau of Economic Research, 2003).} Many potentially commercialisable inventions are simply never disclosed to technology transfer offices.\footnote{Ibid at 2; Jerry G. Thursby, Richard Jensen & Marie C. Thursby, “Objectives, Characteristics and Outcomes of University Licensing: A Survey of Major U.S. Universities” (2001) 26 Journal of Technology Transfer 59.} The perceived solution generally seems to be to offer researchers a greater percentage of future profits. But it is unclear whether this is really what researchers are seeking. In the first place, they probably realise that if profits do eventuate, it is likely to be many years before this occurs. But more importantly, this assumes that researchers are motivated by financial incentives. In this section I argue first, that many researchers are influenced more by traditional academic motivators and secondly, that

those that are motivated by financial considerations may simply by-pass the university technology transfer processes.

**Academic motivators**

There is a growing body of research that indicates that ongoing research funding and maintaining control over future research are the most important motivators for researchers.\(^\text{43}\) Intellectual challenge and autonomy tend to rank much more highly than salary and prestige.\(^\text{44}\) Collaboration and competition (in the academic sense) are both highly valued. The norm of sharing research results and materials continue to exert a powerful influence on the behaviour of researchers.\(^\text{45}\) If patenting is to have value to university researchers, it is more likely to rest with the opportunity to retain control over future research and commercialisation than with financial rewards.

So, it becomes clear that patents are not the drivers that provide university researchers with the incentive to invent. They already have sufficient incentive to do this because of the type of people that they are. What patents provide is the incentive to innovate and researchers have to be convinced that this is a worthwhile exercise if they are to participate with enthusiasm. The possibility that restrictions will be imposed on publication and discussion of research findings at conferences is likely to be one of biggest deterrents against willing participation in the linear model. However, there will often be valid commercial reasons, including the possibility of patenting, why the early publication of results and sharing of uncodified knowledge and materials is not always possible. Even so, it is not necessarily the case that commercialisation per se inevitably leads to a corresponding decrease in the rate of academic publication.

Nevertheless, where patents are involved there is likely to be a longer time lag between research and publication than would otherwise be the case,\(^\text{46}\) which may be unacceptable to many researchers. Such delays will be exacerbated if commercial sponsors require researchers to enter into confidentiality agreements and obtain approval from them before publication of any research results. While patenting requires a certain level of disclosure,\(^\text{43}\) Strandburg, *supra* note 3.\(^\text{44}\) *Ibid*.\(^\text{45}\) Wesley M. Cohen & John P. Walsh, “Real Impediments to Academic Biomedical Research” in Adam B. Jaffe, Josh Lerner & Scott Stern, eds., *Innovation Policy and the Economy*, vol. 8 (Chicago: University of Chicago Press, 2008) 1 at 3.\(^\text{46}\) *Ibid*. at 7-8, 14-15. See also various other research findings referenced therein.
there may be sound commercial reasons why the entirety of the cache of knowledge associated with the invention to be patented should never be released into the public domain, even after the patent has been filed. According to Wes Cohen and John Walsh, patents don’t just require disclosure to be restricted; they could actually increase the “incentive” for researchers not to disclose to protect their commercial advantage.\(^\text{47}\) If extensive layers of knowledge around the patentable invention are not disclosed, this could create significant problems for follow-on researchers.

There is some evidence of voluntary withholding behaviour by researchers, both for commercial and for other unrelated reasons, particularly with regard to sharing of research materials and data.\(^\text{48}\) Yet despite this, Cohen and Walsh report that, more generally, there still continues to be a high level of sharing between academics, illustrating the power of the social norm.\(^\text{49}\) The importance of this norm must be recognised and accepted by universities if they are to develop successful strategies for commercial dissemination of knowledge.

**Commercial motivators**

While much of the impetus for commercial dissemination of university knowledge at the level of the university has focused on formal technology transfer, there is a growing body of evidence that many university researchers engage more directly in technology transfer with industry rather than going through the formal processes established within universities for that purpose.\(^\text{50}\) As such, if a researcher does have the motivation to commercially develop his or her knowledge, the chances are quite high that he or she will choose to do so outside the formal university technology transfer processes.\(^\text{51}\)

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\(^47\) *Ibid.* at 8 [emphasis in original].
\(^49\) *Ibid.* at 17.
\(^51\) For a Canadian perspective on this point, see the following comment by Richard Gold, “Academic Researchers Not Hired To Invent” *Reflections* (21 April 2008), online: Centre for Intellectual Property Policy <http://www.cipp.mcgill.ca/blog/2008/04/21/academic-researchers-not-hired-to-invent/>. 
Although attempts have been made by universities to ensure that ownership of inventions created by researchers vests with the university, the legal position is far from clear. The Australian Federal Court decision in University of Western Australia v Gray (No 20)\(^{52}\) provides a worrying precedent for universities. It is hard to do justice to the 1619 paragraph judgment here, so all I will attempt to do is to distil its essence. The dispute in issue principally involved Dr. Bruce Gray, appointed as Professor of Surgery at the University of Western Australia [UWA] in 1985, Sirtex Medica Limited, a publicly listed company of which he was the director and the Cancer Research Institute, an entity created to support Dr Gray’s research. UWA alleged that Gray had breached his contract of employment and his fiduciary obligations to the university by failing to disclose patentable inventions to it. One of the difficulties for the university was that the court held that its Patent Regulations had not been properly promulgated, as required by its governing legislation. One key aspect of UWA’s case is that it relied on an implied term in Gray’s employment contract that intellectual property developed during the course of his employment belonged to it. Justice French\(^{53}\) did not accept this assertion, stating at paragraph 12 that:

> … I have concluded that the assumption is not well founded. Absent express agreement to the contrary, rights in relation to inventions made by academic staff in the course of research and whether or not they are using university resources, will ordinarily belong to academic staff as the inventors under the 1990 [Patents] Act. The position is different if staff have a contractual duty to try to produce inventions. But a duty to research does not carry with it a duty to invent.\(^{54}\)

Later in the judgment, Justice French conducted a detailed review of the case law in other jurisdictions, including Canada and the U.S.. It seems that in all jurisdictions much hinges on whether or not the employee was hired for the express purpose of inventing.\(^{55}\) Before leaving this point it is worthwhile to ponder on the notion of inventing. In this context, it would

\(^{52}\) [2008] FCA 498.

\(^{53}\) It is noteworthy that since this decision Justice French has been appointed as the Chief Justice of the High Court of Australia.

\(^{54}\) University of Western Australia v Gray (No 20) supra note 52 at para. 12 [emphasis added].

\(^{55}\) University of Western Australia v Gray (No 20), ibid. at paras. 108-143.
seem that the word ‘invention’ is being applied narrowly, in the sense of creating patentable inventions. When used in this sense, it becomes clear why a distinction can be drawn between a duty to research and a duty to invent. In the broader context, inventing might encompass notions of: finding; discovering; fabricating; and producing (as something useful) for the first time through the use of the imagination or of ingenious thinking and experiment. In this broader context, it is much more difficult to make the clear distinction between researching and inventing.

Bearing in mind that Justice French decided that academic staff did not have a duty to invent, he went on to question the value to universities of claiming ownership rights over patentable inventions, particularly because of the costs of administration and enforcement and ongoing uncertainty as to scope and application. His Honour suggested that a better option may be for universities to offer competent and experienced commercialisation services in exchange for a negotiated interest in the relevant intellectual property. While His Honour accepted that inventions could be made by Gray in the course of his research activities as an employee of UWA doing what he was employed to do, this did not give UWA an implied right to his invention.

The circumstances surrounding the Gray case were probably quite common in the 1980s and 1990s, when universities had not developed proper procedures for ensuring that they could claim rights to intellectual property arising from research conducted during the course of employment. Doubtless, many universities have now rectified such problems by ensuring that they have properly constituted intellectual property policies, clear terms in employment contracts and/or deeds of assignment. However, the case itself raises broader issues about whether it is still the case that researchers in the modern university do not have a duty to invent and whether universities should take heed of Justice French’s advice to negotiate an interest in researcher-generated intellectual property based on the provision of commercialisation services rather than claiming absolute ownership rights.

57 University of Western Australia v Gray (No 20), supra note 52 at para. 14.
58 Ibid. at para. 1363.
3.5 The best fit problem

As noted by Owen-Smith and Powell, the drive to commercialise university knowledge developed hand in hand with the emergence of the biotechnology industry out of university laboratories.\textsuperscript{59} As a consequence, commercialisation strategies have been formulated with this industry sector in mind. One of the difficulties for technology transfer offices is that successful strategies are highly technology specific, even within a single sector. Mowery and colleagues provide five case studies that illustrate this point.\textsuperscript{60} For example, in one of these case studies, on cotransformation (a process for transfer of genes into mammalian cells) it was concluded that “technology transfer occurred in spite of rather than because of the patents, licenses and involvement of the university technology transfer office” and that effectively the university patent was a tax on commercial development rather than a facilitator of that development.\textsuperscript{61} In contrast, another case study on Xalatan (an eyedrop solution to treat glaucoma) concluded that patents played an important part in the technology transfer process. Points of distinction include the long lead time to bring the product to market and the need for the inventor’s know how and involvement in the development process.\textsuperscript{62}

Mowery \textit{et al.} say that this illustrates the need for caution in making generalisations about technology transfer and the role of intellectual property rights.\textsuperscript{63} It certainly seems to be a truism that there will be instances where, if managed properly, the linear model enhances the public benefit in the commercialisation of knowledge, but other instances where it may not. It has been argued that the standard model only really applies in biomedicine and, despite its attractiveness in the sense that it is easily grasped and the outputs are relatively easy to measure, it fails to reflect the wide variety of circumstances where universities impact on the economy.\textsuperscript{64}

\textsuperscript{60} Mowery \textit{et al.}, supra note 5 at 152-178.
\textsuperscript{61} \textit{Ibid.} at 159.
\textsuperscript{62} \textit{Ibid.} at 164.
\textsuperscript{63} \textit{Ibid.} at 154.
\textsuperscript{64} Howard, supra note 7, particularly at 38-39.
4. Alternative strategies

4.1 Improving the linear model – aggregation of patent rights

Concerns about the problems associated with the linear model for commercial dissemination of university knowledge have led to discussions about a possible role for mechanisms that aggregate patent rights. The consolidation of patent rights could streamline the negotiation of licences and reduce transaction costs, potentially addressing each of the return on investment, clash of cultures and innovation and access problems. The simplest method for aggregation of patent rights is for a single entity to exclusively license from a number of other entities. Anatole Krattiger et al. and Patrick Gaulé both provide an example of how this scenario might work in the classic context of fragmented patent rights held by a number of academic institutions.

Reverse genetics is a technology that is being used for the development of influenza vaccines. Medimmune, Inc. was able to obtain exclusive licences from three academic institutions which facilitated further development of the technology.

It must also be recognised that, in the wrong hands, patent aggregation could exacerbate the “troll” problem, as noted in Point 8 of the Nine Points to Consider in Licensing University Technology. Point 8 cautions universities to be mindful of the implications of working with patent aggregators, noting further that this can work in the public interest to consolidate rights over foundational technologies and add value through technology-appropriate bundling, as opposed to patent trolling that aggregates rights with no real intention to commercialise. Point 8 ends with the following comment: “the public interest is better served by business models that encourage commer-

67 Ibid.
68 Bienenstock et al., supra note 34.
cialisation than those that rely primarily on infringement litigation to generate revenue.”

Another mechanism for aggregating patents is patent pooling. Patent pools group together patents and license them out as a single package, either by the group of owners or by a separate entity specifically created for the purpose.69 Benefits include streamlined negotiation of licences, reduced transaction costs, distribution of risks and sharing of additional technical information.70 From the public interest perspective, one of the significant difficulties with patent pools is that such arrangements could encourage collusion and price fixing, and provide a shield for invalid patents, all of which raise competition law considerations.71 Many countries have guidelines that provide assistance in avoiding violations of competition (antitrust) laws.72 Despite this guidance, patent pools still remain complex and expensive to set up and operate and there have been few cost/benefit evaluations of existing pools to determine whether they are worthwhile in practice.73 There is also a lack of clarity as to extent to which there must be compliance with rules relating to essentiality of patents in the pool, whether the pool must be formed around standards and if so, what those standards might be.74

70 Clark et al., supra note 65 at 9-10.
74 Frank Grassler & Mary Ann Capria, “Patent Pooling: Uncorking a technology transfer bottleneck and creating value in the biomedical research field” (2003)
A role for clearing houses is also being considered. A clearing house can perhaps best be thought of as any institution whose purpose it is to bring together owners and users of goods, services and information in order to lower transaction costs. There is a wide variety in types of clearing houses, ranging from mere databases of information through to royalty collecting agencies. Intellectual property exchange clearing houses are most commonly seen in the area of copyright, where they are utilised by copyright owners for the collection of royalty payments on their behalf.

A patent clearing house could provide a catalogue of relevant patents and identify the negotiations that have to be undertaken in order to ensure freedom to operate in particular research areas. The clearing house could facilitate negotiations, by acting as an honest broker between owners and users, and could coordinate the development of standard-term licence agreements, collect licence fees and even go so far as to collect royalties on behalf of owners. In this way, patent owners benefit because they have increased opportunities for out-licensing, users benefit because the risk of patent hold up is reduced, and both benefit from reduced transaction costs.

Despite the increasing body of literature endorsing patent pools and clearing houses as mechanisms for improving the linear model for the dissemination of university knowledge, particularly in biotechnology, there is little evidence to date that they are actively being taken up. Preliminary results from a survey that I am currently undertaking in Australia with colleagues in Europe indicate that there is still a perception among many university and industry participants that there is no urgent need to explore these options. Respondents indicated that they had concerns about com-

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plexity, time, expense, loss of exclusivity and inability to engage with all relevant parties.

4.2 Targeted research

Knowledge transfer is not just about licensing of patents. As Mark Lemley points out, university technology transfer offices ought to have as their goal maximising the social impact of technology, not merely maximising the university’s licensing revenue.\(^{77}\) Knowledge relationships with industry developed through contracts and consultancies and even joint ventures and partnerships are becoming increasingly important sources of revenue for universities and may have important social consequences if they facilitate the translation of university knowledge into valuable products and processes.\(^{78}\) The value of such arrangements to industry is that they don’t only have access to codified knowledge in the form of patents or publications, but also uncodified or tacit know how and expertise. Knowledge in this form can and will often be of very high value to industry. Such arrangements may be tied to intellectual property developed through the linear model, but this does not necessarily have to be the case. They may be dependent on previously created intellectual property that forms the "platform"\(^{79}\) for the development of knowledge-based relationships and the exchange of knowledge in uncodified form. In such cases, issues relating to background and foreground intellectual property come to the fore. In the alternative, they may be finalised before any intellectual property has been generated, in which case they may be entirely dependent on researcher expertise. Access to research materials and/or data may also be an important driver.

Industry funding of university-based research has practical value for universities, providing a growing percentage of university revenue streams, particularly when compared with licensing of the patentable outcomes of publicly funded research.\(^{80}\) While this is beneficial in the era of increasing research costs and shrinking public funding, we should be concerned that commercial funding of this nature turns university researchers into mere

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77 Lemley, supra note 22 at 611.
78 Howard, supra note 7.
79 Howard, ibid. at 6.
80 See for example Yochai Benkler, “Commons-based Strategies and the Problems of Patents” (2004) 305 Science 1110 at 1110-1111, indicating that licensing and royalties makes up “an insignificant portion of total university revenues.”
private contractors. Where a researcher is engaged as a consultant, the relationship is effectively one of principal and agent, with the industry partner directing the research and owning property rights associated with it.\textsuperscript{81} This can lessen the prospects for their research to be truly innovative and increases the risk that confidentiality obligations will restrict broad dissemination of research results. Where innovative research does occur, if it is tied to collaborative funding there is a risk that industry partners may be more inclined to suppress it than to develop it. Arrangements of this nature need to be scrutinised with care, to ensure that they do not unjustifiably impede basic university research and knowledge dissemination. As Katherine Strandburg rightly points out, it is not so much that industry funding is the problem, but that such funding might “diminish social and university commitment to providing the kinds of funding and institutional structures that the basic research enterprise requires.”\textsuperscript{82} It would be useful for more empirical data to be collected to test the extent to which industry funding could stifle or enhance basic university research and dissemination of knowledge, including qualitative interviews with researchers and quantitative analyses of comparative publication rates of those academics in receipt of industry funding and those without such funding.

From the industry perspective, the overvaluing problem applies equally if not more so here as with more straightforward licensing of university inventions. Negotiations can be particularly complex when parties each bring background intellectual property to the partnership and new intellectual property will result from the research conducted under the auspices of the partnership. In some instances, these complexities can create an “insurmountable barrier.”\textsuperscript{83} University administrators have been subject to some criticism for delaying contracts because of the perceived need to provide for detailed arrangements for background and foreground intellectual property. Other obstacles relate to the clash of cultures problem: the traditional academic paradigm and the standard commercial paradigm does not encourage collaborative ventures. In addition, funding from industry for individual contracts or collaborations might turn out to be fairly insignificant from the

\textsuperscript{82} Strandburg, \textit{supra} note 3 at 116.
\textsuperscript{83} Hall \textit{et al.}, \textit{supra} note 30.
whole of the university perspective. Researchers may also be unwilling to participate because it removes them from the mainstream academic career trajectory.

4.3 More informal knowledge dissemination models

The mechanisms for dissemination of knowledge discussed so far are referred to collectively by Link, Siegel and Bozeman as formal university technology transfer. They conclude that there is a growing body of evidence that many university researchers are more willing to engage in informal technology transfer with industry participants rather than going through the formal processes established within universities for that purpose. One of the ways in which knowledge is disseminated informally is through social networking. Social networks require no legal mechanisms for support. Rather, they are premised on trust. According to Woody Powell:

Networks are particularly apt for circumstances in which there is a need for efficient, reliable information. The most useful information is rarely that which flows down the formal chain of command in an organization, or that which can be inferred from price signals. Rather, it is obtained from someone you have dealt with in the past and found to be reliable. You trust information that comes from someone you know well.

For social networks to succeed, there must be sufficient trust between university researchers and industry participants. Liebeskind et al. provide empirical evidence that already in 1994 this sort of social networking was emerging in the biotechnology industry. They acknowledge that this industry is “hypercompetitive,” with rapid knowledge obsolescence, scarce investment capital, scarce high quality human capital and high risk of appropriation of valuable knowledge by competitors. Even so, large numbers of new biotechnology firms dedicated to research and development have emerged

84 Link et al., supra note 50.
out of the university sector (and this trend has increased since the Liebeskind et al. study in 1994). These firms are heavily dependent on patents for their survival, but as they are established by university researchers, they also have access to established knowledge sharing social networks. Liebeskind et al.’s research indicates that these social networks survive the test of time, indicating that the norms and values of such networks are sufficiently binding to prevent appropriation and that they are important avenues for dissemination of both university and firm knowledge.

A key focus of this type of informal knowledge dissemination is relationship building, to encourage broad industry-wide adoption of research findings. This strategy recognises that people are far more important than patents. While informal exchanges are unlikely to replace the formal university structures completely, they do make a valuable contribution to knowledge dissemination and could be better facilitated by universities. Universities need to encourage researchers to communicate more freely with industry and move more freely between the two sectors. Other roles for universities might also include: capacity building, education and training, and standard setting.87 Other more formal mechanisms include the establishment of cooperative research centres, knowledge parks and the like.88 However, depending on how these relationships are managed, patenting and licensing can be just as much a source of friction here as with other models of commercial knowledge dissemination.

4.4 Open access – information without strings

The release of raw research results into the public domain can play equally as influential a role in dissemination of knowledge as patenting (if not more so). There is much to be said for foregoing controversial intellectual property rights in certain circumstances in favour of open access to raw data and research materials. There are a number of advantages to be gained by putting this information in the public domain: first, it reinforces the norm of open science; second, it provides an alternative to expensive proprietary information databases; and third, it effectively excludes the patenting option until some additional step is taken.

The Human Genome Project [HGP] provides a good illustration of the way that this open access approach has been employed in genomics. The

87 Howard, supra note 7 at 32.
88 Howard, ibid. at 55-56.
HGP commenced in 1990, and from the outset it was a collaborative venture, both between institutions and between countries. The goals of the HGP were to map all of the genes and to systematically sequence the genetic code for the entire human genome. In 1996, HGP participants agreed in the Bermuda Declaration that primary genomic sequences should remain in the public domain and that they should be rapidly released.\(^89\) GenBank is the publicly accessible repository of the sequence information produced by the HGP.\(^90\)

The sheer scope of the funding commitments to the HGP by participant countries facilitated the release of data without any need for cost recovery. There may be other instances where similar funding commitments are made, but they may be infrequent. While there is likely to be considerable opposition from funding agencies, universities and industry in adopting a broad requirement for open dissemination of knowledge from all publicly funded research (perhaps with the option of an opt out for commercialisable research), there is likely to be more willingness to accept such obligations in limited circumstances. Where large funding commitments are forthcoming, it could be argued that recipients should be obliged to follow the standards articulated in the Bermuda Principles. Funding agencies in a number of countries are already heeding the call to keep research open. Some have already adopted policies of open dissemination of research results, including the U.S. National Institutes of Health,\(^91\) the U.K. Wellcome Trust\(^92\) and Genome Canada.\(^93\) The challenge is finding an appropriate place to draw the line between pre-commercial open access knowledge and commercial proprietary knowledge.

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\(^89\) David R. Bentley, “Genomic Sequence Information Should Be Released Immediately and Freely in the Public Domain” (1996) 274 Science 533.

\(^90\) GenBank, online: National Center for Biotechnology Information

\(^91\) U.S., National Institutes of Health, *Final NIH Statement on Sharing Research Data* (February 26, 2003), online: National Institutes of Health


\(^93\) Genome Canada, *Data Release and Resource Sharing Policy*, online: Genome Canada
5. Conclusion

The process of commercially disseminating university knowledge through the linear model is a fine “balancing act.” Technology transfer managers have to drag often-reluctant researchers into the process and negotiate with industry partners who do not necessarily value the time and finances involved in generating new knowledge. Funding agencies demand engagement with industry, but provide little guidance and assistance in how to achieve this end. Success is measured by short-term returns even though product development and royalty payments are likely to take many years to eventuate. Universities are put into an unenviable position of having to compete for attention from industry. The chance of hitting the jackpot is remote. Ownership issues are complex.

There will be some circumstances where patenting and licensing is an appropriate strategy. The question is whether, on balance, this justifies every university in the industrialised world having its very own technology transfer office dedicated to the task. For the smaller universities, in particular, other strategies should be examined. Aggregation of rights is one option, consolidation of the technology transfer offices themselves is another. But in some circumstances it might, in fact, be more appropriate to decentralise rather than further aggregate, giving individual researchers ownership of their intellectual property and leaving it to them to identify commercial opportunities. The university could then provide expert assistance to researchers, including directing them to appropriate experts. Other mechanisms for dissemination of university knowledge also need to be given due consideration and support.

One dilemma for universities, as rightly pointed out by John Howard is a choice between two conflicting policy options:

- disseminating knowledge for broad industry application through non-exclusive licensing and general courses and programs with potentially small financial return; or

- producing knowledge for specific business applications or needs, to be licensed or delivered exclusively, with a potentially larger return.\(^{95}\)

\(^{94}\) Link \textit{et al.}, \textit{supra} note 50 at 6.

\(^{95}\) Howard, \textit{supra} note 7 at 7.
But beyond this, the question that remains is whether broader limitations should be placed on commercialisation of publicly funded research. Given the evidence presented above on the costs of the linear model, closer scrutiny needs to be paid to bald statements to the effect that commercialisation maximises public benefit.

The linear model for commercialisation of knowledge has been a key strategy in the dissemination of biotechnology knowledge, but even here it is questionable whether this strategy, of itself, has been causative of downstream innovation. The risk of reliance on this model is that patenting at the level of basic university knowledge could actually deter rather than facilitate the development of downstream technology. The benefits in terms of financial return on investment do not appear to be flowing in abundance. As such, even in biotechnology, slavish adherence to the linear model is not an optimal strategy.

It may be even less desirable to follow this model in other research sectors. In information and communications technology [ICT], for example, the distinction between basic scientific research conducted at universities and technological research usually conducted by industry is much more clearly demarcated than for biotechnology,96 suggesting that there is little value in patenting and licensing university inventions in this field. Moreover, in ICT the speed of technological development suggests that rapid dissemination is of overriding importance and that patenting and licensing could create unnecessary delays. Here, disseminating knowledge for broad industrial application may be a more appropriate strategy. On the other hand, in engineering, where the focus of research is on the design and manufacture of complex products,97 there may be much to be said for using patent protection to facilitate product development, as well as contracts and consultancies, but only when university engineers are involved in downstream technological development rather than upstream research. For those university research sectors that do not have technology as their core function, but focus more on basic scientific discovery, traditional open forms of dissemination should prevail.

This article calls for a nuanced approach to dissemination of university knowledge, taking into account the diversity of scientific disciplines and the

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96 Howard, supra note 7 at 39.
types of knowledge generated by those disciplines, and also bearing in mind that commercial dissemination is but one part of the university mission. Although the drive for universities to commercialise has been a dominant force for the past 25 years, in looking to the future, it is important to reflect on what we want our core university values to be. Open dissemination of knowledge has served us well in the past and should continue to play a dominant role. Large-scale endeavours like the Human Genome Project and follow-on projects show just how successful the open access model can be.

This call for greater emphasis on the open access model is not made in isolation. For example, a recent review of innovation in Australia reached similar conclusions, noting that research commercialisation is not a core role for universities and, although there will be instances where the benefits of research are best achieved through commercial engagement, such instances are in the minority. 98 Rather:

Universities … are Australia’s engine room for discovery and invention and are the principal creators and disseminators of new knowledge. In fulfilling this function the universities are places dedicated to taking intellectual risks, where scholars can test and develop their ideas with peers from around the world. 99

99 Ibid.