A Guide to Metrics on Knowledge Transfer from Universities to Businesses and Industry in Australia*

Paul H. Jensen, Alfons Palangkaraya and Elizabeth Webster

Intellectual Property Research Institute of Australia
Melbourne Institute of Applied Economic and Social Research
University of Melbourne

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Intellectual Property Research Institute of Australia
The University of Melbourne
Law School Building
Victoria 3010 Australia
Telephone: 61 (0) 3 8344 1127
Fax: 61 (0) 3 9348 2353
Email: info@ipria.org
www.ipria.org

SUMMARY

- This report serves as a guide to quantitative and qualitative metrics for measuring the extent of knowledge transfer (KT) from universities to businesses and industry in Australia.

- It is based on a framework recently proposed by UNICO's and consists of broad set of metrics that cover different dimensions of knowledge transfer activities from Australian universities to industry.

- There is robust evidence from other advanced countries that in university-industry relationships, formal collaboration through intellectual property rights commercialisation activities represents only the "tip of the iceberg" that is underpinned by less formal activities such as informal contacts, networking and university-industry mobility of researchers.

- Unfortunately, currently available and/or proposed metrics for Australia are still more or less narrowly focused on the "tip of the iceberg".

- Using the UNICO framework as a starting point allows for direct international comparisons of Australian universities' knowledge transfer activities to industry.

- The recommended set of metrics cover the following nine categories of knowledge transfer activity:

    1. *Networks:* Number of attendances/presentations at conference/seminar with industry (non-academic) participants; Number of PhD student exchanges (with industry); Number of collaborative and contract research projects as a result of knowledge exchange or networking activities;

    2. *Continuing Professional Development:* Number of CPD courses held; Number of attendees at CPD courses; Number of university-industry lab researcher exchanges; Number of other scientific and research training schemes for industry; Participation feedback;

3. *Consultancy:* Number of consultancy contracts; Value associated with consultancy contracts; Number of collaborative research projects generated by consultancies;

4. *Collaborative Research:* Number and value of ARC Linkage projects; Number and value of other collaborative research agreements (including CRCs); Number and value of joint ventures; Number of (new) products/processes successfully created from collaborative research (e.g., as reported in the ARC/CRC final report);

5. *Contract (Commissioned) Research*: Number and value of contract research projects; Length of client relationship; Number of contract research projects which led to other flow-on knowledge transfer activities such as collaborative research, licensing, and industry sponsored conferences;

6. *Licensing*: Number of invention disclosures; Number of complete standard patent applications (including PCT); Number of patents granted; Number of plant variety rights; Value of copyright licenses; Number of licenses (LOAs); Income stream from licenses (LOAs); Long term relationships created following licensing;

7. *Spin-outs*: Number of spin-outs formed; Value of revenue generated by the spin-out; Value of external investment raised; Market value at flotation (or initial public offering); Exit value (i.e. at trade sale or buy-out); Survival rate/viability of spin-outs; Growth rate of spin-outs;

8. *Teaching:* Number of student graduation by course type; Rate at which students get hired (in industry); Student satisfaction (after employment); Employer satisfaction with graduates;

9. *Other:* Number of research student placements in industry; Number of industry funded postgraduate positions/scholarships; Number of staff working on commercialisation activity in dedicated and support roles; Provision of training in research commercialisation; Research Publications A1, B1 Reported to DEST; Citation received (citation impacts analysis) from articles and patents with industry co-author(s) or inventor(s); Joint publications and inventions.

- Most of the proposed metrics require data that are already collected by universities.
- For those metrics of which the data are not currently available, we recommend the following actions:

    1. Seminar and course participation feedback survey data, if standardised, are potential sources of information on networking and informal contacts.

    2. In order to capture which KT activities lead to other KT activities, a couple of questions such as how did it materialise, over what period did the relationship evolve before the proposal was made, or will it continue in the future (i.e. after this project) can be asked at the end of each ARC Linkage application or other collaborative and contract research applications.

    3. Databases such as the Web of Science and patent application databases combined with *bibliometric* analysis can provide meaningful metrics on knowledge transfer activities.

- To obtain a more complete picture of the extent of knowledge transfer from universities to industry in the longer term, research investigations need to be conducted using longer term data possibly collected from specialised surveys in addition to the metrics proposed here.

INTRODUCTION

This report serves as a guide to quantitative and qualitative metrics for measuring the extent of knowledge transfer (KT) from universities to businesses and industry in Australia. The metrics are based on measures of knowledge transfer activities and their immediate effects. To achieve this, we have taken a broad approach to identifying activities that universities undertake, rather than just a narrower set of commercialisation activities (e.g. number of patents or licensing activity). Our intention is that this report will be:

i) a guide to what data *should* be collected given the focus on long-term objectives associated with Australia's economic prosperity and wellbeing; and

ii) a preliminary checklist of what data *are currently* available from the universities.

Numerous other (domestic and international) reports have focused on the issue of the measurement of commercialisation activities including those by the European Commission (2009), UNICO[1], KCA (2008), DEST (2005), and SPRU[2]. In principle, these reports advocate a move to a broader set of knowledge transfer metrics. In particular, after consultations with the major stakeholders of knowledge transfer, namely the research funders, the universities and the business community, the UNICO report proposed a broader set of metrics based on knowledge transfer activities. For the case of Australia, similar consulting process of the stakeholders was undertaken by the Australian Government's 2005 Working Group (WG) on Metrics of Commercialisation which concluded that "After examining current practice in Australia and overseas, and analysing 22 submissions from organisations, [we have] concluded that current metrics for commercialisation of publicly funded research need to be extended to reflect a broader understanding of the commercial and economic benefits of research commercialisation" (p.4).[3]

They have also raised awareness about the potential problems associated with short-term goals. For example, informing technology transfer offices in universities that they are to be measured on the number of patent applications in a given year may simply provide an incentive to submit patent applications for inventions which were never intended to be commercialised, which is clearly

[1] See Holi *et al.* (2008).
[2] See Molas-Gallart *et al.* (2002).
[3] See DEST (2005).

socially wasteful. In addition, recent research in Australia has reinforced the view that knowledge created in universities can take a long time (20+ years) to reach the market. Appropriate commercialisation metrics should recognise this and should incorporate a range of short-, medium- and long-term indicators. The Working Group also recommended that Australia's research KT metrics should be: Specific, Measurable, Actionable, Reliable, Timely, Cost effective, and Efficacious. In light of these issues and international comparability considerations, we have attempted to follow the KT metric templates in these earlier reports, and have embellished them where necessary.

PROPOSED KNOWLEDGE TRANSFER METRICS

In this Report, we follow the UNICO's framework by identifying a broad set of metrics that cover different dimensions of knowledge transfer activities from Australian universities to industry. The UNICO's framework serves as an excellent starting point because it takes into account recent observations that knowledge transfer activities from universities to industry are of a much broader spectrum than activities related to the commercialisation of intellectual property rights.[4] In addition, we also need to ensure that the metrics reflect the view that universities contribute to society over and above their traditional focus on teaching and research. As a consequence, we have not simply focused on a narrow set of commercialisation metrics, but have considered the entire gamut of ways in which universities enrich Australian industry and business community.

In fact, citing an OECD (2002) report and a study by Cosh *et al.* (2005), the Australian Government (2009, p. 60) realised that, with regards to the university-industry relationships, "[f]ormal collaboration is the tip of the iceberg, which is underpinned by many less formal links" and that "[f]irms in the United States and the United Kingdom regard informal contacts as the most important type of university-industry interaction contributing to innovation, ahead of graduate employment, research publications and technology licensing." Unfortunately, as shown in the Appendix of this report, currently available and proposed metrics for Australia are still narrowly focused on the "tip of the iceberg".

[4] See, for examples, the findings of Schartinger *et al*. (2002), Agrawal and Henderson (2002), Mowery and Sampat (2005), Cohen *et al.* (2002) and many others as cited in D'Este and Patel (2007).

The other reason why we use the UNICO framework as a starting point is that it opens the possibility for making direct comparisons between the measured performance of Australian universities and those of universities in the United Kingdom, Canada and the United States, to begin with. In addition, the framework uses as much publicly available information as possible. Each of the metrics is discussed below.

Nevertheless, our main interest is not on the knowledge transfer activities per se, but on the effects that this knowledge has when taken up by third parties, in particular the industry. In other words, our real interest is not how many new inventions a university produces, but the economic effects of the commercialisation of these inventions. Such effects could be felt in terms of increasing productivity in industry, the export dollars created by new inventions, or the consumption of new products based on these inventions. To be sure, these effects are incredibly difficult to measure at the university level. But it is important to recognise that university technology transfer offices should not simply be judged on their short-term goals such as the number of patent applications in a given year. In reality, the creation of a new invention is simply the start of the next phase of the complex process of commercialisation. One way in which this could be measured would be to survey business and industry about the effects of their collaboration, consultancies and licensing interactions with universities.

In the next section, we document our proposed knowledge transfer metrics. In this documentation, we also provide an indication regarding the required data availability at the universities based on the information made available by universities as summarised in reports such as DEST (2007) and KCA (2008), the sources indicated in DEST (2005), and the types of available information from the University of Melbourne's records.[5] Furthermore, we have distinguished between knowledge transfer activities and knowledge transfer effects (because we think this is an important distinction to make). However, we recognise that capturing the effects of knowledge transfer is rather difficult, especially the long term ones, therefore our proposed metrics are mostly concentrated on the immediate effect. Finally, in our presentation, the forms of knowledge transfer are arranged in ascending order of formality: beginning with informal networks and ending with legal defined arrangements. As stated above, to allow for direct international comparisons, we follow

[5] It should be noted that our data check list is to be considered preliminary at best.

the UNICO report in defining the different knowledge transfer forms. The final section presents a few ad hoc metrics.

Networks

Networking comprises informal contact and association between groups of people. According to the UNICO report, networks "can be an important measure of the knowledge transfer activities of a university, as they directly facilitate the exchange of knowledge between individuals. Importantly, they can also result in other downstream activities of knowledge transfer, such as collaborative research." We have tried to capture indicators which reflect both i) the direct facilitation of knowledge exchange; and ii) the effects of such knowledge exchange. Separating these issues in this way (i.e. knowledge exchange and the effects of knowledge exchange) is quite different to distinguishing "quantity" from "quality" of knowledge transfer, as has been done in some other metrics reports.

In this way, participation in a seminar or workshop may be an indicator of some knowledge being exchanged between participants and is therefore included as an important indicator of knowledge transfer. We then investigate whether such knowledge exchange activities resulted in the development of joint research proposals, collaborative research or the like since these are the types of outcomes which should be nurtured. Nevertheless, we are cognizant of the fact that while the effects of knowledge transfer are very important, they are incredibly difficult to observe. At present, there is no systematic way in which these effects are currently collected and to impose this administrative burden on the academics (or the universities) may be problematic.

With regard to gauging the effects of knowledge transfer activities (which is currently unknown), one possibility would be for DEST to require the ARC to put a couple of questions at the end of each ARC Linkage application (for example) about the genesis of the research collaboration with industry; how did it materialise?, over what period did the relationship evolve before the proposal was made?, will it continue in the future (i.e. after this project)? Of course, universities could do the same thing with regard to contract research projects – they could be required to ask researchers how these materialised, particularly if they are industry-university relationships.

Networks	Are the data available from universities?[6]
Knowledge Transfer Activities	
Number of attendances/presentations at conference/seminar with industry (non-academic) participants	No
Number of PhD student exchanges (with industry)	Yes
Knowledge Transfer Effects	
Number of collaborative research projects as a result of knowledge exchange or networking activities	No[7]
Number contract research projects as a result of knowledge exchange or networking activities	No[8]

Continuing Professional Development

Continuing professional development (CPD) comprises executive education and seminars for professional workers. It is distinct from teaching "because …CPD deals with individuals from other professions that are not affiliated with university, where as teaching primarily involve students enrolled in the university." The UNICO report states that "CPD can be a means of directly enabling the transfer of new knowledge from its academics to individuals from other professions, who may not ordinarily have access to such knowledge." The key to this knowledge transfer metric is that it relates to teaching activities that are external to the University. Of course, university staffs are also interested in continuing their own professional development, but the focus of this metric is how much training the University provides for the wider community – particularly in industry and the professional services.

One example of CPD activity would be presentations made by academics to non-academics (e.g. patent attorneys) who receive points from a professional services accreditation board for their attendance. We draw a distinction here between a course and a presentation. While both involve a presentation made by an academic to a non-academic audience, a presentation is defined as a short (less than 2 hour) talk while a course is defined as more substantive (greater than 2 hours).

[6] "Yes": available from university records; "Maybe": available but may not be recorded by the university regularly; "No": not available.
[7] A possible data source is from asking ARC Linkage applicants with regards to the genesis of their proposed research. See text for details.
[8] See the discussion on Contract Research below.

Garnering information on the effects of these activities may be done by formally collating participation feedback surveys. Participation feedback surveys are commonly undertaken after seminars either through hard copy questionnaires or email follow-up. To collate this information at the national level would require agreement on a standard question or questions to be included in each survey.

Continuing Professional Development	Are the data available from universities?
Knowledge Transfer Activities	
Number of CPD courses held	Yes
Number of attendees at CPD courses	Yes
Number of university-industry lab researcher exchanges	Maybe
Number of other scientific and research training schemes for industry	Maybe
Knowledge Transfer Effects	
Participation feedback	Maybe

Consultancy

A key characteristic of a consultancy – which distinguishes it from contract (or commissioned) research – is that it involves advice rather than a written report or any original research. For example, management academics may be approached by business to provide some advice on how to restructure their operations, academics may participate on an industry or community advisory committee *inter alia*. These activities may involve several days work by the academic, but it need not involve any written report or a formal analysis of their production operations.

Many academics engage in the provision of consulting services – in fact, most teaching academics have explicit provisions in their contract to allow them to provide 1 day per week of consulting services. This is an important component of an academic's activities since it enables direct personal interaction between academics and non-academics. Since such consultancy arrangements are typically initiated by external professionals, it is a clear indication that the academic is potentially able to address a problem that requires fixing (and the professional is prepared to pay for). In other words, the academic has some skills that are not otherwise available to the external party (or professional). This implies that the academic is providing an important service

to the community. Moreover, such consultancies can lead to the development of longer-term relationships and the formulation of other collaborative research agreements.

Consultancy	Are the data available from universities?
Knowledge Transfer Activities	
Number of consultancy contracts	Yes
Knowledge Transfer Effects	
Value associated with consultancy contracts	Yes
Number of collaborative research projects generated by consultancies (see below)	No[9]

One of the difficulties with measuring consultancy work is to know where to draw the line between part-time academic staff who also work in a professional/clinical area and full-time academic staff who undertake consultancies in addition to their full time teaching and academic duties.

Collaborative Research

Collaborative research is jointly funded research, typically involving a public grant body, an industry partner and the university. Actual participation by industry is required to make the research collaborate: the partner organisation in an ARC Linkage project, for example, will provide input into the nature and scope of the project (via an in-kind contribution), over and above their financial contribution. Collaborative research is typically longer term than a one-off consulting project or contract research and commonly involves bigger projects which take longer to complete. According to UNICO, collaborative research "is more focused on meeting the needs of all concerned parties through collaboration [compared with contract research] which satisfy[s] the external partner first and foremost."

Collaborative research is an important conduit of knowledge transfer between academia and industry, government and business. It can also be a precursor to other knowledge transfer activities such as licensing or spin out. The interaction between academia and external organisations via

[9] See the earlier discussion on adding a couple of question on, say, ARC Linkage application to indicate the genesis of the proposed collaborative research project.

collaborative research agreements can have important impacts on the transfer of technology from universities to the private sector, which has clear productivity implications for productivity growth. However, these effects are probably too far down the stream to be used as indicators. Instead, we propose the use of the number of products/processes (i.e., patents or diclosures) resulting specifically from the collaborative research.

Collaborative Research	Are the data available from universities?
Knowledge Transfer Activities	
Number and value of ARC Linkage projects	Yes
Number and value of other collaborative research agreements (including CRCs)	Yes
Number and value of joint ventures	Yes
Knowledge Transfer Effects	
Number of (new) products/processes/publications successfully created from collaborative research (e.g., ARC/CRC final report)	Maybe[10]

Contract (Commissioned) Research

Contract (or commissioned) research typically involves larger projects, original research and a written report. It is commissioned usually by a single external organisation. This may have important implications for the ownership of any intellectual property generated during the course of the project, but this issue will not be addressed here.

Contract research is probably most prevalent in non-teaching research institutes, since such institutes often rely on external funds. Typically, academics in these research institutes actively seek contract research (via response to requests for tender), in addition to direct requests for consultancies (which may not be advertised). Of course, the distinction between academic research and consultancies (or commissioned research) is not always as clear cut as one would like – that is, the two may not be mutually exclusive. There are potentially many instances where some commissioned research may, in fact, have an academic output (in the shape of a journal publication or book chapter). In such instances, the academic's work should be regarded as having multiple outcomes. In

[10] Data on jointly invented patents or jointly authored publications are available from patent and Thompson databases as noted later.

addressing the immediate effects of a contract research project, we use the value of contract research as a revealed preference indicator. For the longer term effects, one can consider the number of problems solved, which could be analysed by surveying clients at the completion of a project.

Contract (Commissioned) Research	Are the data available from universities?
Knowledge Transfer Activities	
Number of contract research projects	Yes
Length of client relationship	Maybe
Knowledge Transfer Effects	
Value of contract research projects	Yes
Number of contract research projects which led to other flow-on knowledge transfer activities such as collaborative research, licensing, industry sponsored conferences, etc.	Maybe

Invention Disclosures and Formal IP

One of the most important mechanisms through which knowledge may be transferred from universities to industry is via licensing, which usually involves a legal contract (which may be exclusive or non-exclusive) enabling a third party to use a patented idea or copyrighted expression.

A well recognised route for transferring technologically based ideas from universities to the private sector is via invention disclosure, to patenting and then to licensing. Licensing is the legal mechanism via which third parties can utilise a technology created within the university, without the university necessarily giving up its ownership rights. As their immediate effects, licensing arrangements can also lead to other downstream knowledge transfer activities such as consultancy, collaborative research, or the formation of spin-out companies. In the long run, rather than focusing on the value of all licenses generated by universities, we need to focus on the effects of licensing activity (such as productivity improvements). This is because economic theory indicates that publicly funded research bodies should aim to maximise technology transfer not raise revenue through the sale of knowledge.

Licensing	Are the data available from universities?
Knowledge Transfer Activities	
Number of invention disclosures	Yes
Number of complete standard patent applications (including PCT)[11]	Yes[12]
Number of patents granted[13]	Yes
Number of plant variety rights	Yes
Value of copyright licenses	Yes
Knowledge Transfer Effects	
Number of licenses (LOAs)	Yes
Income stream from licenses (LOAs)	Yes
Long term[14] relationships created following licensing	Maybe

However, patent licenses are not the only way in which university-created knowledge can transfer into the public domain. Universities also generate a wide range of outputs which are protected by copyright and are then licensed to third parties. Disseminating university knowledge through licensing teaching curricula has become increasingly important in recent years. Since such material is covered by copyright – and unlike patenting, there is no formal registration of copyrighted material – it is difficult to capture data on copyrighted material. Therefore, we must rely on the income generated through licensing copyrighted material. Such knowledge transfer can have important benefits for society via increasing the overall quality of teaching and through the standardisation of teaching curricula.

Spin-outs

Spin-outs are companies formed when an entity from within the university becomes an independent business. According to UNICO, "…the formation of companies that have been spun-out from higher education institutions, is an essential mechanism of the knowledge transfer activities of universities, particularly with regards to IP exploitation." Spin-outs are another way in which the university may create social value. However, spin-outs are commonly unsuccessful, so it is very important not to focus on the number of spin-outs created, without analysis of their survival rates and their economic

[11] Count for each separate jurisdiction separately.
[12] This and number patent grants can also be sourced from patent databases provided by patent offices.
[13] Count for each separate jurisdiction separately.
[14] For examples, how many years have the relationships continued, how many other LOAs or collaboration with the same company, etc.

effects. We discuss possible metrics designed to capture the nature and effects of this knowledge transfer activity below.

Potentially, the effects of spin-outs may be felt through their long term financial viability and growth. Thus, the two proposed measures of effects, survival rate and growth rate of spin-outs, are probably to be collected less frequently and subject of the longer term analysis.

Spin-outs	Are the data available from universities?
Knowledge Transfer Activities	
Number of spin-outs formed	Yes
Value of revenue generated by the spin-out	Yes
Value of external investment raised	Yes
Market value at flotation (or initial public offering)	Maybe
Exit value (i.e. at trade sale or buy-out)	Maybe
Knowledge Transfer Effects	
Survival rate/viability of spin-outs (long term)	No
Growth rate of spin-outs (long term)	No

Teaching

Probably the most important way in which universities shape society is through the education of their undergraduate and graduate students. This can be measured via a number of mechanisms including the number of students graduating in a given year (by course), and by the rate at which such graduates enter the workforce since that is where most of the economic benefits of their graduation will be realised. The qualitative dimension of a student's experience at university is currently evaluated using the Graduate Destination Survey, which has some information on the level of graduate satisfaction with the course they took. Although there are a number of caveats to bear in mind when using student evaluations of lecturers (e.g. students may dislike a professor simply because they failed an essay), these surveys are an important source of information on the qualitative dimension of a student's experience.

Teaching	Are the data available from universities?
Knowledge Transfer Activities	
Number of student graduation by course type	Yes
Rate at which students get hired (in industry)	Yes
Knowledge Transfer Effects	
Student satisfaction (after employment)	Yes
Employer satisfaction with graduates	Maybe[15]

On the other side of the ledger, it is important to understand how satisfied the employer is with the university graduates. Many large employers of recent graduates have a unique opportunity to compare and contrast the quality of students from different universities. In the past, the University of Melbourne has attempted to capture some of this information via their Employer Feedback Survey. Perhaps there are other institutions which do the same, since there is a strong incentive for the universities to be able to compare their students. However, there is also good reason to collect such data systematically (by the Government rather than the universities) since it provides an invaluable (and objective) way to analyse university performance on this key dimension of their knowledge transfer activities.

Other mechanisms

There are a range of other knowledge transfer activities that have not been covered in the metrics described and discussed above. We cover these other miscellaneous types of knowledge transfer activities in the following section. For examples, there are two important indicators that are not categorised elsewhere that can be used to measure knowledge transfer effects: number of citations received and joint publications/inventions. While the data to construct these indicators are not available directly from universities, they are readily available from databases such as Thompson Scientific SCI database, patent office databases, and the Web of Science.

[15] This may be measured by employer revealed preference in the sense that if the rate at which students get hired (in industry) it indicates the employers in general are satisfied.

Other mechanism	Are the data available from universities?
Knowledge Transfer Activities	
Number of research student placements in industry	Yes
Number of industry funded postgraduate positions/scholarships	Yes
Number of staff working on commercialisation activity in dedicated and support roles	Yes
Provision of training in research commercialisation	Yes
Knowledge Transfer Effects	
Research Publications A1, B1 Reported to DEST	Yes
Citation received[16]	No[17]
Joint University-Industry publication[18] and invention[19]	No[20]

[16] Citation impacts analysis in terms of citation received from articles and patent applications where the citing articles/patents have co-author(s) or inventor(s) from the industry.

[17] Possible non-university sources include Thompson Scientific SCI database for citations by articles and patent databases from EPO or USPTO for citations by patents. See also Williams and Van Dyke (2007) who used Thompson citation database for ranking Australian universities.

[18] This can be limited to publications in international journals.

[19] This can be based on the listed inventors shown in patent applications.

[20] See Tijssen *et al.* (2009) who used the Web of Science to rank 350 universities in the world according to university-industry joint publication. See also Abramo *et al.* (2009).

APPENDIX

In this appendix, we tabulated the various knowledge transfer metrics that have been used or proposed to be used by reports from overseas (UNICO and SPRU) and domestic (KCA and DEST). Included in the tabulation are metrics that have been used by a sample of existing studies[21] which may also fall under UNICO's classification of knowledge transfer mechanisms. The purpose of the tabulation is to identify any existing gap in terms of the metrics used and data availability as well as overlaps so that we can come up with a set of metrics for measuring Australian universities' knowledge transfer activities to industry which are internationally comparable and relatively easy to construct in terms of data requirements.

Using UNICO report's framework as our starting point of the tabulation,[22] we identified similar metrics used by each of the other reports and our best guess[23] regarding the availability of the required data from Australian universities. Unlike the UNICO report, we used the term "effects" rather than "quality" to group the metrics that measure variation in the levels of quality of the activities. The idea is that the variation in quality would be reflected in the variation of the effects of the knowledge transfer activities.

Metrics of Knowledge Transfer Activities	Are the data available from Australian universities?[24]	Used/Proposed by				
		UNICO	SPRU	Other	DEST	KCA
Networks						
Measures of quantity						
Number of people met at events which led to other KTA	No	X				
Number of engagements (meetings attended, conferences given, etc.) in which the academic has been providing advice to non academic audiences).	No		X			
Attendance at conferences with university and industry participation	No			X		
Client relations (No. of contacts/interactions)	No				X	
Attendance at industry sponsored meeting	No			X		
						Continued…

[21] These studies include Schartinger *et al.* (2002), D'Este *et al.* (2005), D'Este and Patel (2007) and Bekkers and Freitas (2008).
[22] UNICO's metrics are italicised.
[23] We checked whether or not the data are available from our University, the University of Melbourne, as indicated by their website as well as from the information in the National Survey of Research Commercialisation. In order to have a complete check of the availability of the data we need to survey all Australian universities, which is out of the scope of the current report.
[24] "Yes": available from university records; "Maybe": available but not recorded regularly; "No": not available.

		UNICO	SPRU	Other	DEST	KCA
Personal contacts via membership of professional organisations	No			X		
Staff holding positions in both a university and a business (secondments to industry)	Yes			X		
Measures of quality						
Percentage of networking events which led to other downstream KTA	No	X				
Continuing Professional Development (CPD)						
Measures of quantity						
Number of CPD courses held	Yes	X				
Income from CPD courses	Yes	X				
Number of people that attend CPD courses	Yes	X				
Number of companies represented in the CPD courses	Maybe	X				
Scientific & research training for industry (No. of courses & graduates)	Yes				X	
Measures of quality						
Percentage of repeat business	Maybe	X				
Customer feedback surveys conducted after CPD courses	Maybe	X				
Consultancy						
Measures of quantity						
Number of consultancy contracts	Yes	X			X	
Number of contracts and consultancies entered into	Yes					X
Value (income) of consultancy contracts	Yes	X			X	
Gross contracted value	Yes					X
Share of consultancy contracts in total research income	Yes	X				
Market share of consultancy contracts	Yes	X				
Number of client companies	Yes	X			X	
Length of client relationship	Yes	X				
Measures of quality						
Percentage of repeat business	No	X			X	
Customer feedback	No	X				
Quality of client company	No	X				
Sectors and company size	Maybe				X	
Importance of client relative to their company	No	X				
Flow-on business (No. of clients who become patent licensees and/or partners in JVs, spin-outs, etc.)	No				X	
Collaborative Research						
Measures of quantity						
Number of collaborative research contracts/grants	Yes	X				
Number of ARC Linkage projects	Yes				X	
Value/income of collaborative research contracts/grants	Yes	X			X	
Value of ARC Linkage projects	Yes				X	
Market share (of collaborative research income)	Yes	X			X	
Share of collaborative research income in total research income	Yes	X				
Length of client relationship	No	X				
Use of university facilities by firms	Maybe			X		
Staff exchanges (No. of researchers to industry; industry to research sector)	Yes				X	

Continued…

		UNICO	SPRU	Other	DEST	KCA
Sharing facilities (e.g. laboratories, equipment, housing) with universities	Yes			X		
Measures of quality						
Percentage of repeat business	Yes	X			X	
Customer feedback	No	X				
Number of products successfully created from the research	No	X				
Contract Research						
Measures of quantity						
Number of contract research contracts	Yes	X			X	
Number of contracts and consultancies entered into	Yes					X
Value (income) of contract research	Yes	X			X	
Gross contracted value	Yes					X
Market share	Yes	X				
Share of contract research income in total research income	Yes	X				
Length of client relationship	No	X			X	
Number of commercial arms (firms set up by universities to carry out contract research)	Maybe		X			
Measures of quality						
Customer feedback	No	X				
Repeat business	No	X			X	
Number of products successfully created from the research	No	X				
Flow-on business (No. of clients who become patent licensees and/or partners in JVs, spin-outs, etc.)	No				X	
Licensing						
Measures of quantity						
Number of licenses	Yes	X			X	
Number of LOAs executed	Yes					X
Number of LOAs active	Yes					X
Number of LOAs yielding income	Yes					X
Income generated from licenses	Yes	X			X	
Adjusted LOA income ($000)	Yes					X
Number of products that arose from those licenses	No	X			X	
Sales resulting from technologies licensed	Yes					X
IP Protection	Yes					X
Invention disclosures received	Yes				X	X
Number of new patent and/or plant breeder rights filled	Yes				X	X
Number of applications for PCT and interim IP protection	Yes				X	X
Provisional patents	Yes					X
PCT patents	Yes					X
Innovation patents	Yes					X
Other	Yes					X
Total number of patents and plant breeder rights issued	Yes					X
Patents pending	Yes					X
Patents issued	Yes					X
Rights culled or lapsed	Yes					X
Funds committed to IP management	Maybe		X			
Costs and frequency of litigation over infringement of IPRs	No		X			

Continued…

		UNICO	SPRU	Other	DEST	KCA
Measures of quality						
Customer feedback	No	X				
Quality of licensee company	Maybe	X				
Number of license to international companies	Maybe					
Percentage of licenses generating income	Yes	X			X	
Spin-Outs						
Measures of quantity						
Number of spin-outs formed	Yes	X			X	
Number of start-up companies formed during the year	Yes					X
Number of spin-outs that have realised a capital increase during the year	Maybe					
Revenues generated	Maybe	X			X	
External investment raised	Maybe	X			X	
Capital raising total and IPO (Value and number)	Maybe					X
Market value at flotation (or initial public offering)	Maybe	X			X	
Value of all equity holdings	Maybe					
Exit value (i.e. at trade sale or buy-out)	No	X				
Joint ventures (No. & capitalisation)	Maybe				X	
Measures of quality						
Survival rate/viability of spin-outs	Maybe	X				
Number of spin-outs that have ceased operation	Maybe					
Number of start-up companies operational dependent on licensing/assignment of technologies	Yes					X
Number of start-up companies in which an equity holding	Yes					X
Quality of investors	No	X				
Investor/customer satisfaction	No	X				
Growth rate of spin-outs	Maybe	X				
Teaching						
Measures of quantity						
Graduation rate of students	Yes	X			X	
Rate at which students get hired (in industry)	Maybe	X				
Research graduates employed in industry (Number and percent of total cohort)	Maybe				X	
Course design - industry input & endorsement (No. of postgraduate courses with industry input to design and/or industry endorsement)	Maybe				X	
Number of joint supervision of Ph.D. and Masters theses	Maybe			X		
Financing of Ph.D. projects	Maybe			X		
Number of lectures at universities, held by firm members	Yes			X		
Postgraduate Research Experience Questionnaire (PREQ)	Yes					
Measures of quality						
Student satisfaction (after subsequent employment)	No	X				
Employer satisfaction of student	No	X			X	
Industry satisfaction with quality of research graduates	No				X	
Number of students as co-creator of University owned IPs	Maybe					
Research postgraduate income	Maybe				X	
Research postgraduate start-ups & spin-outs	Maybe				X	

Continued…

		UNICO	SPRU	Other	DEST	KCA
Other Mechanisms						
Measures of quantity						
Physical migration of students to industry		X				
Research student placements in industry	Maybe				X	
Students working as trainees	Maybe			X		
Industry funded postgraduate places	Yes				X	
Research postgraduates employed in spin-outs	Maybe				X	
Publications as a measure of research output	Maybe	X				
Research Publications A1, B1 Reported to DEST (Apportioned)	Yes					
Citations counts (citation impacts analysis)	No					
Peer-reviewed publications & reports (No. & type)	Yes				X	
Number of joint publications with industry	No					
Resourcing for commercialisation						
Annual TTO budget	Yes					
Number of staff working on commercialisation activity in dedicated and support roles	Yes				X	X
Commercialisation staff cost	Yes				X	X
Fees and legal costs to secure IP protection	Yes					X
Number of institutions providing training in research commercialisation	Yes					X
Total training participants	Yes					X
In-house delivery participants	Yes					X
External delivery participants	Yes					X
Commercialisation & entrepreneurial training for researchers (No. of courses offered, No. of graduates)	Yes				X	
Measures of quality						
Research postgraduates income	No				X	

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