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Official Committee Hansard

**HOUSE OF  
REPRESENTATIVES**

STANDING COMMITTEE ON SCIENCE AND INNOVATION

**Reference: Pathways to technological innovation**

MONDAY, 5 DECEMBER 2005

CANBERRA

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**HOUSE OF REPRESENTATIVES**  
**STANDING COMMITTEE ON SCIENCE AND INNOVATION**

**Monday, 5 December 2005**

**Members:** Mr Georgiou (*Chair*), Mr Quick (*Deputy Chair*), Mr Hayes, Mr Jenkins, Dr Jensen, Miss Jackie Kelly, Mr Price, Mr Tollner, Mrs Vale and Dr Washer

**Members in attendance:** Mr Georgiou, Dr Jensen, Mr Quick, Mr Tollner, Mrs Vale and Dr Washer

**Terms of reference for the inquiry:**

To inquire into and report on:

Australian technological innovation and pathways to commercialisation, with particular reference to examples of successful Australian technological innovations that demonstrate strategies to overcome potential impediments and factors determining success.

To assist in its inquiry, the Committee seeks to compile a series of case studies of successful technological innovations, and the pathways to commercialisation. Submissions are sought detailing successful examples of Australian technological innovations.

Submissions are also sought with particular reference to successful innovations, on issues such as:

- pathways to commercialisation;
- intellectual property and patents;
- skills and business knowledge;
- capital and risk investment;
- business and scientific regulatory issues;
- research and market linkages;
- factors determining success; and
- strategies in other countries that may be of instruction to Australia.

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**Committee met at 4.36 pm**

**ARTHUR, Dr Evan, Group Manager, Innovation and Research Systems Group, Department of Education, Science and Training**

**BORTHWICK, Ms Jessie, Group Manager, Science Group, Department of Education, Science and Training**

**HARPER, Mr Gregory Paul, Deputy Chief Executive Officer, Australian Research Council**

**HOJ, Professor Peter Bordier, Chief Executive, Australian Research Council**

**WALKER, Dr Stephen Joseph, Director, Engineering and Environmental Sciences, Australian Research Council**

**CHAIR (Mr Georgiou)**—I declare open this public hearing of the House of Representatives Standing Committee on Science and Innovation into pathways to technological innovation. The inquiry arises from a reference to this committee by the Minister for Education, Science and Training, the Hon. Brendan Nelson. There have been 96 written submissions to date and the committee has been conducting public hearings and informal discussions. This is the 10th hearing for the inquiry.

Although the committee does not require you to give evidence under oath, I should advise you that the hearings are formal proceedings of the parliament and warrant the same respect as proceedings of the House itself. It is customary to remind witnesses that giving false or misleading evidence is a serious matter and may be regarded as a contempt of the parliament. I invite you to make an opening statement before we proceed to questions.

**Dr Arthur**—I will make the very briefest of opening statements. I hope that the submission indicates that both groups understand that this is both a very important and very complex issue. We have a range of policies and programs to address the issues but we by no means consider that we have a complete range of policies or programs. We are very much looking forward to the contribution that the committee will make in taking forward our examination of the issues and the advice that we can provide to government on what might be good to do for the future.

**Prof. Hoj**—I will just complement that by saying it is great to be here. We enjoyed putting the submission together because it focused our minds. I was particularly pleased to see that it was pathways to technological innovation because in the past few years there has been a very narrow focus on what is good innovation and what is bad innovation. Perhaps we can discuss these things a bit further but I would like to talk not only about commercialisation of innovation but also commercial benefit, and those things can be slightly different.

**CHAIR**—I have a couple of minor points to get out of the way. The DEST submission says that there are data gaps and that all this data costs a lot of money. In 2001-02 the NSRC cost \$400,000, excluding respondents' costs. Can I rush in and make a fool of myself by saying that that seems to be a pretty minimum amount of money and by no means a substantial amount. I am surprised that it would be regarded as a significant expenditure.

**Dr Arthur**—It certainly would not be a significant expenditure of administered funds but it does represent a significant amount of departmental funds. Any information gathering activity is always costly, not just in direct costs but also in indirect costs. You have to consider the value you are getting for that. We certainly believe it is a justified expenditure to try to get a better handle on this important issue.

**CHAIR**—This is one of the most pressing issues. I am not having a go at you but when I saw that I almost fell out of my chair. Four hundred grand over two reports is peanuts. What would it cost you to do it properly and comprehensively so that it could add to our capacity to evaluate what was happening? We are spending very substantial amounts of money on the programs. I do take your point but it strikes me that a lot of the time we are walking around in a data morass and a very real conceptual morass and I am just surprised. If that is regarded as a lot I would like to know how much it would cost to gather the data that you need to have to make adequate policy decisions.

**Dr Arthur**—We certainly are of the view that it is very important to get better information. The real additional costs are not going to be the costs that are borne by the agency. The real issue is the costs that are going to be out there within the system. We certainly do not regard our current data collecting activities as adequate and there are a number of initiatives, which we mentioned in our submission, pushing us towards getting better information. The problem is always that, for example, if you wish to get better information on the extent to which a particular patent has or has not generated revenue or the extent to which a particular joint venture has or has not generated revenue or, turning in a different direction, the extent to which contracts and activities of university staff have generated revenue and those revenues have been directed towards improving a particular industry, to do all of those things we need to get the agreement of the universities and other players to record that information in the first place. In most cases the only information is either not recorded or it is not recorded in a way that is easily brought together.

My personal view on all of these issues is that the way forward is not to produce new iterations of one-off surveys or, indeed, a continuing survey, but to have a detailed plan for going forward to work out what information you are really going to be interested in through time and work out ways in which that information can be captured but also, most crucially, captured in a standard way so that your cost of bringing that data to a central point is reduced. I would agree very much, Chair, that that is an ever-important thing to do given the nature of the issue and the very large size of the outlays going out. I would only caution that when you get to do it, it is not a simple process, but I agree with your initial take on the issue.

**CHAIR**—Concerning the developments in the UK in terms of the third stream, can you lay that on top of what we are doing and give us the rationale for why the UK is going there and why we are doing what we are doing?

**Dr Arthur**—Indeed. We think that in terms of broad principle there is much of interest in the UK third stream or third appendage—the terminology tends to wander around a bit—in that it recognises overtly that there is value to the community from the engagement of universities directly with communities, particularly in terms of commercial benefit. As Professor Hoj indicated in his opening statement, there are benefits to the economy. The precise details of how third stream works in the UK are probably not transferable because every country has its own



particular system of funding things and there are elements of the Australian system which work in particular ways which are not directly comparable with the detail of the UK system. In terms of the precision of it, you would not obviously want to a direct transfer across.

However, I think the minister has certainly indicated—he indicated most clearly in a speech he made at the national stakeholder forum on the research quality framework—that he is very interested in receiving advice from the university and the research sector more broadly about how the principle behind third-stream funding could be most effectively employed in Australia. Professor Hoj may wish to add to that.

**Prof. Hoj**—One of the issues of comparing systems from country to country is that the systems already existing in those countries are different. In Australia, we have some schemes which go a long way towards enhancing that innovation pathway that you are so interested in. Under DEST's regime, a cooperative research centre scheme is run which brings together end users and people in publicly funded institutions. In our own patch, we have a large proportion of the ARC's budget—some \$119 million per annum now—that goes towards running a so-called Linkage scheme, where there is a requirement for a co-investment between the ARC, a university partner and an end-user partner, a collaborating partner, to the extent that—and Dr Walker can correct me if I am wrong—we get in the order of \$1.5 to \$1.6 co-investment from the end users to match the ARC funding.

One of the things that we are seeing is that there is a very high degree of repeat business—and that is one of the best indicators, in my view, of whether people like a scheme or not—to the extent that the willingness in applications from end users to invest in the ARC has grown from about \$150 million per annum in 2001 to some \$300 million projected for 2005. Is that right, Stephen?

**Dr Walker**—Those are the requests to the ARC in those years, yes.

**CHAIR**—Leaving aside the idiosyncrasies of the two systems, what is the main thrust of what the Brits do, and what is the closest parallel that we have here to what they do?

**Dr Arthur**—I would say that the main thrust which does exist—and it is mentioned in a number of the submissions made to the committee—is that the British funding scheme does provide substantial funds in the hands of universities, overtly for them to engage in these engagement activities. There is not a direct parallel in the Australian case. We have specific programs such as the CRC program and the ARC Linkage programs, and we have the general research funding.

**CHAIR**—Can you just develop the British aspect a bit more?

**Dr Arthur**—The key fund there is the Higher Education Innovation Fund. I do not have the dollar or pound figures in my head—

**CHAIR**—No, just the general thrust.

**Dr Arthur**—but it is a substantial fund, in the hundreds of millions of pounds, which is provided on a formula. I would caution that I do not see that part of it as being particularly

appropriate to the Australian case, but it provides significant funds that are available to be spent by the universities. They need to be spent on activities which are directly to improve their engagement with communities, and with industry particularly.

**CHAIR**—So they commit to using it in a particular way, but it is their money?

**Dr Arthur**—Correct.

**CHAIR**—Unlike here? What happens here, in contrast to the British system?

**Dr Arthur**—In our case, the universities receive research funding. Roughly, from DEST, there is about \$1 billion annually which is allocated: half of that, roughly, for research training and the other half on two schemes which are competitively performance driven. But that is provided for the full suite of research activities. The point was made in a number of submissions to the committee, which I would not disagree with, that because of the inevitable ways in which universities tend to see the world they will tend to spend that money on the actual research—which is good—rather than on the application of that research. So the argument is made that, by having funding which, in the way it is provided, is marked as being for the application of research, that provides a very direct incentive for universities to pay attention to that aspect and to be particularly forward in trying to ensure that they have the appropriate engagement, particularly with industry, so you do get the application of research.

**Prof. Hoj**—I think there is one element to add there—that is, to look at the drivers which give esteem within a university in particular. I think it is fair to say that universities recently have moved towards a broader recognition of the activities that lead to the translation and application of knowledge, but traditionally, if you wanted to get promotion through the university system, you would have been better off focusing on scholarly activity alone.

It is a big picture that needs to be addressed. Certainly that is the current thinking that is going on through the activities in relation to the research quality framework. The minister has said that he is very keen to see that we also focus on rewarding people who are good at impacting outside their own disciplines. But those drivers need to be in place because if they are not in place people will go towards what will put them in a position to feed the family, so to speak.

**CHAIR**—To put it crudely, the universities have argued: ‘Give us money so we can actually focus on this activity. We’re not going to divert money from our established activities, because you underfund us anyway, and we would like to have a cut of money so that we can actually use it to develop the commercialisation-innovation component.’ Why don’t we just say yes?

**Dr Arthur**—Because I am a government official I am limited in terms of how much I can say, but that sounds like an excellent idea. If that were to be the case, it would need to be linked to good performance measures. This goes back to your data issue. The government and taxpayers would want to have the ability to know that it was being looked on in terms of the universities saying: ‘Thanks very much. We’ll keep doing what we are doing.’ We would want to be able to establish how it was being used. The world being the way it is, I think you would want to have it linked to the differential performance of universities, so that the universities which demonstrated that they were using it in the most effective manner would be rewarded for that. That would

provide a driver which would tend to mitigate the risk of this simply being rent-seeking behaviour.

**CHAIR**—That is different from what we do now because we actually try to get them together with people, whereas this involves saying, ‘This is what we are giving you the money for; you go and do it and we’ll assess you at the end of it.’

**Dr Arthur**—I think it would need to form part of an overall suite of measures. No one mechanism works best. You would certainly want to keep on the programs that provide direct incentives to partner with people. But I think there is some force to the case that good universities could make very effective use of some funds which were available at discretion but within the constraint that they could show they were using it effectively.

**Dr JENSEN**—I remember back in the days when I was doing my PhD, the focus on potential outcomes outside the university system—the production of knowledge—was not a big impetus. How do we foster that these days? How do we better foster it for the future? This next question is not directly related to the last two questions: how do we improve linkages between researchers, academics and industry? After all, personal contact is a very big feature in getting a constructive arrangement.

**Dr Arthur**—I certainly agree with the last comment. All the research shows exactly that: those connections are very powerful on both sides. Clearly, there is no simple answer because if there were we would have done it a long while ago. I think we understand, increasingly, that we need to provide the kinds of signals which will enhance that behaviour. There are a number of things which we are doing to try to achieve that. We would certainly be interested in hearing suggestions about what more we could do. For example, the research quality framework—which my group is working on with the assistance of Professor Hoj—is one very powerful driver. It will provide a ranking of individual research units within Australian universities, and we will allocate funds on that basis.

One of the very important issues we are discussing right now is the balance within that. Clearly, you want to continue to give signals of academic excellence for doctorates. It has to be good research; there is no point funding it if it is not. But also within that we are trying to get people to focus on the extent to which that can be applied and should be applied. There is no simple answer but at a policy level government does have, and must continue to have, both objectives in sight. We are trying to send out signals which do both of those things.

There is one thing we have not done enough in the past. Certainly from DEST’s point of view—and I suspect the ARC has the same view—we should not be seeking to directly influence the promotional activities of universities, but we certainly should be discussing with universities the importance in their own internal processes of recognising appropriately the balance between pure research and the application of that research.

**Dr JENSEN**—On that issue, do we need to perhaps have a clearer distinction between pure research and applied research, so that people who are working in the pure research areas are aware that they work in the pure research area but if there are some benefits that flow so be it, whereas for people who are working in applied research it is very clearly defined that this is what it is and the expectation is not just that you produce papers but there are other outcomes.

**Prof. Hoj**—I think it is very clear to know what is pure research and what is applied research. However, one of the issues is, of course, that today's pure research will turn into the basis for applied research. So if you try to separate institutionally, for example, these processes you have got to have very good transfers between the institutions. So I would just caution against going too far down that route, but there might well be things to consider. In terms of forming linkages between, say, industry and institutions, we are educating so many PhDs now that it is imperative that many of them see their future occupation outside the universities. That is the only way the system will work. I know that in the CRC scheme there are about 2,000 PhD students educated in that scheme. Perhaps Stephen can tell us what we are doing in our ARC Linkage scheme.

**Dr Walker**—Yes. And to answer your previous question, the ARC provides quite a strong incentive to encourage researchers in universities to make form external alliances and links with a whole range of external bodies by running its Linkage scheme. It is our second largest scheme. It is about 20 per cent of our budget or, as Peter said, over \$100 million a year. We fund the university researchers, but you cannot unilaterally come to the ARC and apply; you have to first go out and get a partner and you have to convince that partner to put in at least matching resources in cash and in kind. So if you want to ask us for \$100,000 you need to find \$100,000 from your partners. That scheme has grown dramatically in the past number of years. It was formerly the SPIRT scheme, up until 2001, and then Linkage from 2002.

In the last five years requests in that scheme have grown between two and three times—the requests for ARC funding—but what that means is that the researcher capacity to go out and get commitments to match that has grown by a similar amount. We are seeing great numbers of repeat business. We look at all the final reports, which of course are from projects that are now some years old in terms of their funding, and a very large majority of partners in that scheme indicate that the project to them is either beneficial or very beneficial. It is hard to quantify what commercial outcomes happen, because most of the commercial outcomes happen after the end of the projects that we fund. Nevertheless, the activity in that scheme is growing very rapidly.

**Dr JENSEN**—In terms of connections, in an academic sense the majority of the connections that you make tend to be not strictly formal. Conferences, for example, are a great way of the getting these connections academically. Should there be some similar mechanism for the linkages between industry and different research? I know that with some conferences there is some industry input but I am talking about a more structured level, directly arranging things so that the two can meet.

**Dr Arthur**—I certainly think that as a matter of course it would be good if there were more placements of people who are doing doctorates in the industry sectors that they are working in. A number of universities do this. There is a lot of cooperation with CSIRO in that area. But I have no doubt that a lot more could be done in that early stage in giving people that connection. The government as a limited contribution to this did, in the BAA 2 announcements, announce some funding for people who are doing doctorates to engage in some activities associated with entrepreneurship. That was important initiative.

**Dr JENSEN**—In this case I am not just talking about students, I am talking about academics as well.

**Dr Arthur**—I think the same principle applies. Universities are already doing a lot of that and, overall, we think that things are moving in the right direction. But we also would not in any way question that the speed and the scale could do with some improvement.

**Ms Borthwick**—The cooperative research centre program not only brings together research industries and agencies such as the CSIRO but also has a training component within it, which allows PhDs to experience more of that sort of industry.

**Prof. Hoj**—Another thing comes up here, and I just want to supplement what Stephen said. At the ARC, we fund, I think, up to 500 per annum Australian postgraduate award industries, so it has to be a collaborative project. Linkages are normally formed through people. Hopefully, if these students decide to pursue a career outside academia, you have the perfect link. But I think there is another point that we have to bring into the discussion here, and I preface that by saying that I was the director of the Australian Wine Research Institute for seven years, which is a proprietary limited company; it has to sell research so I know how hard it is. But that industry's practitioners were so engaged that they ensured we put on conferences and they would get on the conference committees. It is not only the reluctance, perhaps of academics, to say, 'Let's run a conference with an industry focus;' there is also a need for an increasing appetite in our industry to go to the university and say, 'We want to work with you.' It is two-way traffic that is too slow in both directions.

**Dr JENSEN**—How do we foster it from the industry side? With the academic side there is acceptance of a conference—it is an accepted part of the job—whereas, with industry, in many cases it would be comparatively new.

**Dr Arthur**—It is something we need to do more on. Certainly the overall rural research and development model is very good in getting that kind of engagement. It has its particular origins, obviously, in that sector, which is used to the concept of levies and research associated with that. That does not usually find a ready parallel in other industry sectors, but it is immensely powerful in providing the connection between researchers and the people who are going to be using that research. Also, interestingly, it is based on a model that is interested in the dissemination of the research to have an economic impact in the economy much more than it is interested in revenue capture by patenting and licensing. It is all about the economy but it is an economy that benefits by dissemination. It is of interest from that point of view.

The overall issue of industry engagement in research and development is a difficult one. Australia, as is well known, has lower overall business investment and research and development than most comparable OECD countries. There is argumentation about that. That is largely associated with industry structure, but there is no question that that is an important issue. We certainly have, along with the particular industry departments, a range of measures designed to address that, but I think we all agree that that is one area where we would like to do better.

**Ms Borthwick**—Having said that, it is interesting that in recent years we have seen in the CRC program an increase in industry investment in the program. It is small scale.

**Dr Arthur**—If you create the right conditions.

**Prof. Hoj**—It is a long-term gain of incremental improvement. It is about educating people in a collaborative spirit—someone going out, forming the linkages and telling the good stories. But I think that there is another issue, and that is coming to the realisation that if you are educated to a high level—a PhD level in a university—the numbers are now such that you should see it as a great thing to go outside. One of the issues, I think—and this is pure speculation—is that many of the people who train our PhD students came from an era where that was never on the map, so we almost have to train the trainers to say, ‘Listen, you don’t have to start your own lab to be successful; there is another pathway.’ It is about a multitude of interactions—social and cultural approaches—and they need to work in concert.

**Mr QUICK**—On page 26 of your submission, under the heading ‘Appendix 4: Executive summary from Howard report, you say:

... the standard model does not in fact adequately reflect the wide range of circumstances through which universities impact upon the economy.

You go on to say:

The report addresses this challenge by proposing a more comprehensive and realistic framework for understanding research commercialisation and knowledge transfer.

Can you explain to a layman why this more comprehensive and realistic framework is better than the standard model?

**Dr Arthur**—Yes. With the standard model we are talking particularly in terms of this: you have an idea, you wish to commercialise that idea, you patent it and then you try to drive revenue either by licensing or setting up a spin-out company, which is a very important model of commercialisation. But, as the Howard report showed in terms of the data, that actually produces a minority of the income to universities from the exploitation of their intellectual property. Rather more income is derived from other mechanisms, and the report sets out those figures out in a table. It also then proposes, in a table that is also in the report, a taxonomy of the ways in which you have exploitation of intellectual properties of universities and other forms of properly funded research, which is more closely aligned to the facts. The facts are that there is a range of interactions which produce both revenue and economic benefits. You need a model that captures that otherwise you are ignoring those facts.

**Mr QUICK**—So what is the difference in output between the standard model and this proposed model?

**Dr Arthur**—It is a wider range of data that you are trying to capture. You are not simply trying to capture just less revenue from patenting and then licensing spin-outs. You are trying to capture revenue from consultancies with particular firms that produce both revenue for universities but also transference of intellectual property of value to the companies. A lot of university activity is in fact commissioned research where they do a piece of research and the university receives some money for that but that piece of commissioned research is of direct value to the processes of the company. Or there is the employment model whereby someone goes from a university, spends time with a company and that transference of intellectual property

leads to beneficial results in the bottom line of that company and an array of other activities which are set out in the report.

**CHAIR**—Given that we cannot measure very much at the moment, we are getting very sophisticated in what we are attempting to measure some time down the track.

**Dr Arthur**—Some of those ones we can measure at the gross level. Our problem is that we cannot track it back in detail for universities. We have broad statements from universities' annual reports of contract out, income in et cetera. The Howard report does the best it can with that data, but in terms of pushing that data really hard—who is doing it better than others and what it does really mean—yes, we do run into some data gaps.

**Prof. Hoj**—One of the additions to the framework that Evan was talking about was to recognise incremental change in practices. It is quite evident that it has happened over 10 years, but there has been a decision not to put it through a traditional commercialisation vehicle. That happens quite frequently particularly in the agricultural industries. I can talk about the reduction of spray use in agriculture and about water use efficiency improvements. Often some industries will say, 'We don't want you to tie this up in a commercialisation vehicle because it will, everything else being equal, slow up the adoption of that technology where it really matters'—and in this case it was at the farm gate. When we say, 'Are we really good at what we are doing in R&D?' we are often looking at whether we go from A to Q in terms of a device. It looks totally different but often we do not give any real credit for the incremental improvement in practices that do not lend themselves necessarily to a spin-off company and capital raising. They are both important but it should not be that one approach is to the exclusion of the other. Those are broadly some of the issues.

**Dr Arthur**—For another example, work that has been done on the CRC program that has not yet been published has been looking at some examples of direct dollar benefits from that program. An example which comes to mind, and I will not go into too much detail, is in the area of mining where you have research which leads to a result that, instead of having to go out and buy X number of new drag lines—which are massive pieces of capital expenditure—you are able to retrofit improvements to your existing equipment. The result is not a patenting or licensing stream, because there is nothing to patent or license in that sense. The result is a very large dollar return to the industry in terms of capital expenditure that did not need to be undertaken.

**Mr QUICK**—So which model did the wine industry use?

**Prof. Hoj**—The wine industry was very much—

**Mr QUICK**—Was it the Howard model?

**Prof. Hoj**—Yes, the broader model. Often, we had an issue in convincing the government of the merits of this. We said, 'You want us to have a commercialisation strategy, but we don't have a strategy other than a dissemination and uptake strategy because if we do it any other way the industry will not support it.' So there are different horses for different courses. I think in the biotech industry you would be absolutely mad if you did not protect your things with patents et cetera. So this is really just about having a broader view.

**Dr Arthur**—All it is really doing is reflecting the way industry works. In the case of biotech and pharmaceuticals the industry works by patenting and licensing. That is the basic model for the industry. Agriculture does not work that way and other, different industry sectors have their own particular ways of working. In many cases they work by having trade secrets rather than through patenting and licensing. The so-called Howard model is just trying to look at how the world actually works and have our policies adapted to that rather than to something else.

**Prof. Hoj**—There is one very important point here about trade secrets. One of the drivers we have for showing how clever the country is in terms of innovation is our patenting activity. When you patent something you actually publish your technology and, in some cases if you have a really tight system within your company, a trade secret may be the way to go because nobody knows how you are getting away with doing these things for relatively low input costs so that your margins look good. We just need to broaden the understanding of what it means to be innovation smart and adoption smart.

**Mr QUICK**—How well do governments understand that, when they are interested in giving you money and wanting outcomes?

**Prof. Hoj**—We are in the process of helping the government understand this.

**CHAIR**—We are very grateful.

**Dr Arthur**—We are looking forward to this committee assisting us in that process.

**Mrs VALE**—I have a very short question which follows on from a question by Dr Jensen. Dr Walker, are all your ARC Linkage grants given to universities that are in a partnership with a private sector organisation?

**Dr Walker**—No, they are not. They are all given to universities. I do not know the numbers but in dollar terms, the private sector makes up anything from 50 to 65 per cent of those contributions from partners—depending on which round, who has applied and that sort of thing. It varies from round to round but the majority of the contributions come from the private sector; the remainder comes from non-profit agencies, state and Commonwealth governments and from overseas governments.

**Mrs VALE**—What are your main hopes and objectives for the Linkage program? I understand Mr Quick was talking about models in the questions he asked. Do you have defined outcomes against which you can measure the success of your Linkage program?

**Dr Walker**—There are a range of objectives of the program, which are defined in the funding rules—the formal document which sets out the program. They are to enhance collaboration in the innovation sector broadly between the university based researchers and a broader range of entities and to provide environments for research training that have more practical outcomes and practical applications in terms of the projects they are engaging with, and those sorts of things. They are the main objectives of the scheme. I guess, in measuring outcomes, we have a range of key performance indicators in the ARC's strategic plan that we report on in our annual report every year. Linkages is included in that in some detail.



**CHAIR**—I would like to ask a question about something that has been bothering me. I cannot find my way through these programs. I keep on being told, and your presentation says, that it is important we take a broad view. I have no problems with that, but your program structures are just so complex, who can find their way around it? Dr Arthur, I bet that you could not tell me what programs your department runs.

**Dr Arthur**—All of the programs the department runs?

**CHAIR**—No, in this area. I am serious because we are talking on the one hand of broadening our perspectives but on the other hand we are making our grant programs more and more focused—or at least we are giving that appearance. What is the justification? Politicians spin off new programs to meet new political needs but I do not know how this system works because you need to be a very pedantic bureaucrat to find your way through the programs.

**Dr Arthur**—I do not think I want to defend every element of our—

**CHAIR**—No, this is a genuine issue.

**Dr Arthur**—It is a very genuine issue. There is always a tension between trying to make a program fit a particular policy objective and also putting particular accountability requirements around it, which you are required to do, and being open and responsive. Certainly the most responsive program structure would be to say to universities: ‘Here’s a large amount of money. We think you should do some good things with that.’ That would be the end of it. That would be a very responsive program structure. Between that and a program structure which ties everything down, you have a wide spectrum of possibilities. We certainly have been progressively trying to make sure that we have a good balance for that. My colleagues in the industry department—for example, in Backing Australia’s Ability 2—certainly did roll together a number of industry assistance programs into the one commercial ready and tried to address that—

**CHAIR**—As they are rolling others out, they are rolling some in. Why I am concerned is that it is not just about universities. If you are someone who wanted to get access to some support, you would have to find your way through this thicket. The access points are multiple, the project designations are multiple. Although we have got people out there telling them about them, I do not think some of the people know the full range of options. These are the people that we pay to actually publicise these programs. Is there a midpoint between—

**Dr WASHER**—If you do sell them that, can you come back on public policy and tell us how we can do the same because I think we have greater problems than you have?

**Dr Arthur**—It is not an easy issue; I think we would agree with that. We try to do what we can. Particularly these days we would try to provide information on the web and make that hopefully as clear as possible, but I do not want to guarantee that we are completely successful in that. It is a very important issue, which, amongst other things, we are always looking at how we can improve.

**Ms Borthwick**—In relation to the CRC program, we recognise that problem. This year we have been arranging a series of breakfast seminars and sending out a very wide series of invitations to those to promote the program and to help understanding of it. I also think it is fair

to say that in working through the RQF process, certainly between ourselves here as colleagues and between DEST and the ARC, we have been working very closely together, taking into account exactly the sorts of things you have been talking about in terms of existing programs.

**Prof. Hoj**—It is a challenge. One of the advantages of being in a small agency is that we do not have as many programs. I can tell you what we run, but I will not. What we try to do at the ARC increasingly is to get our experts out. Recently I went to the Hunter Valley to talk to the Australian Mineral Industry Research Association and outlined to them what we are doing. I think on Wednesday last week Stephen Walker talked to the forestry association about what we are doing. We turn up to the Rural Development Corporation. So there is a massive communication effort that is required because, if we are not serious about that, the situation you outlined is true. It just looks like a morass and it is difficult. We could probably do it even better but it would have to be across-government coordinated.

**Dr Arthur**—One thing I would add to that is that you have a number of submissions which point out the value that can be played by intermediary organisations. This area is no different from other areas where there certainly is quite clearly value in intermediary organisations who have to be carefully and modestly funded but often provide very good value—in fact, understanding the nature of their client group, understanding the nature of government programs and being good at brokering the connections between them. A number of those comments made on those submissions I would certainly support—that is, the value of there being intermediary organisations, given that with the best will in the world government is going to remain a complex beast, and I do not see the processes which lead to the creation of a number of government programs I going away any time soon.

**CHAIR**—We did some work with one of the agricultural grants programs. This is one department, one group, that essentially gives them money to help them. The program complexity was such that you could not even advertise it because you had to rig it so it looked rational because it was not. There was a need there, but what happened at the end of all that was that the people who were supposed to access it did not know what it was and did not know where to go.

**Dr Arthur**—I would not underestimate the complexity but you need to look at the history of the programs. The CRC program is a very good program to look at. If you look at the history of our programs I think that by and large we have learnt the lessons of providing guidelines, which are meant to assist people. We have a number of mechanisms that do assist people through those programs. The CRC is a very good example of that. It has progressively evolved, as a result of the evaluations, to respond to exactly those problems of people needing to understand how to get through to the appropriate phase in the program.

**Ms Borthwick**—And indeed continue to review it to try and meet the needs of applicants.

**Dr Arthur**—If you look at a number of our programs, including the ARC programs, in terms of the stakeholders and the degree of consciousness and access to those programs, it is not perfect but I think the record is increasingly good.

**CHAIR**—If you were going to give a third tier or third arm to the universities, how much would you give and how would you constrain it?

**Dr Arthur**—I do not think I could answer the first question. I would be speculating in an area which I am not really competent to speculate in. As I indicated before, I would want to constrain it by making it competitive, and, to a degree, I would want to have a set of indicators for reasonable evidence of success to provide the funds differentially to those who are more successful in those activities.

**Prof. Hoj**—I would endorse that. It would have to be a competitive, merit based process that gives people access to that funding because there would be no shortage of people who would say they would do it well. There has to be some credibility to that. I will not give a figure either. You would not be able to do it for peanuts though. You could get an idea about what happens in the UK and then scale the population sizes.

**Mr QUICK**—Can you tell me a bit about the discovery projects? You mentioned two examples—the spot welding and Mach 10 projects. Your submission says there is \$260 million supporting ‘excellent fundamental research by individuals and teams.’ Does that necessarily promote linkages with industry?

**Dr Walker**—It does not explicitly promote linkages with industry. It is the ARC’s largest scheme. It accounts for about half of the ARC’s budget. I guess it is the most prestigious scheme in the academic world in terms of profile and research. It is probably the only scheme in Australia, along with its equivalent in the NHMRC for medical research, which provides funding for individual researchers to pursue their passion, to essentially remain at the cutting edge of what they are very good at. As I said, it is the only mechanism in Australia which provides funding for individuals to pursue what they do best. Because of that, it is a vital scheme in the ARC’s overall basket of schemes for building and maintaining capacity in the Australian universities for research. I would say it is essential for the next step, which is the linkage and collaborative schemes and the more applied schemes, because it is that fundamental capacity which gives you the ability to exploit it later on.

In Linkages, the second largest scheme, which I have already talk about, it is not a different cohort of researchers applying; it is often the same researchers who are also doing their discovery research. I think increasingly there is a trend as we progress for researchers who are doing their basic research using a combination of the university’s resources, block funds and the ARC’s discovery money to then apply that research and those skills in a broader environment externally using more applied funding and contract research via the CRC scheme and the ARC’s Linkage scheme. I think that is something which is evolving over time. Ten or 20 years ago, I would not have thought you would have seen too much of that. I would have thought there might have been a sharper divide between the cohort of researchers who did the basic science and the cohort who did the applied science. But I think, particularly with younger researchers coming through, they are able to engage on both of those fronts. Although I do not have figures here to present to you today, I think it is very clear that a large number of researchers who are applying in Linkage are also applying in discovery. It is there ongoing discovery money which gives them the capacity for their engagement in Linkage.

**Dr Arthur**—Even historically, you can find plenty of examples of the surprising linkage of basic research with applications. An anecdote I particularly like is that, prior to the Second World War, a number of mathematicians who were probably your caricature of very strange academics doing very strange things with numbers were taken to Bletchley Park and applied to

cryptanalysis. They could arguably have made as large a contribution to the result of the Second World War as any other group of people. So you have a nice little example of the extent to which quite strange, abstruse activities can have very real applications in quite surprising ways.

**Prof. Hoj**—One of the things that we need to look at—and the chairman has just outlined to us how complex the total system is—is that the government invests probably some \$5.6 billion per annum in what we would broadly call R&D and R&D capability, and the ARC is about nine to 10 per cent of that. So half of that budget really constitutes four to five per cent of our total investment in R&D. If that is one of the few places where you can have discovery led research that leads to breakthroughs, that is not a very large proportion of the total system. I just wanted to make that point.

The other point I want to make is to exemplify what Stephen said about people doing discovery also wanting to do Linkage. We have just recently announced our largest Linkage grant in the ARC. It was an \$8.6 million grant that went to the so-called Australian Minerals Science Research Institute, and that \$8.6 million investment by the ARC was matched by \$7½ million from the minerals industry, \$2½ million from the Australian states and \$4 million from universities. The key people who moved into the Linkage grant were people who had also operated in our so-called most prestigious discovery based research centres, our centres of excellence and our special research centres. So the continuum is starting to work, and there is co-investment at the other end of the continuum. We are starting to see things moving in the right direction, but it is a large cultural shift and it will not happen overnight.

**Mr QUICK**—Some people would argue that, with the astronomical rise in oil prices, why do the mining industry need money from the government for research and development? When they are adequately compensated or have the capacity themselves, being large multinationals and with the price of copper, coal, iron ore and the like going through the roof, why are we funding that research?

**Dr Arthur**—It is a phenomenon right around the world, including the United States, that industry does not fund what they regard as basic research. You will certainly find industry which will be involved in the application of research, but it is a true area of market failure that governmental involvement in the fundamental research is essential to kick those processes off.

**Dr Walker**—It is also precisely because they are large multinationals that they can spend their research dollar anywhere in the world.

**Dr Arthur**—Indeed.

**Mr QUICK**—So we want them to spend it here?

**Dr Walker**—Yes. If Australia wants the research activity and wants the spin-off benefits in terms of training, technological capacity and innovation elsewhere in the surrounding industries, the only way to do that is to make Australia an attractive place to spend their research dollar, and that is by funding the best and brightest. Essentially, they will go where they can solve their problems most effectively. We need to have the people who can do that for them and who are competitive with people elsewhere in the world.

**Mr QUICK**—How do we measure that in the long term? Is it by the number of PhD students in the mining industry or by the increased productivity in the mining industry?

**Prof. Hoj**—Probably all of the above. Quite clearly, some people will ask that question and if you ask that question in isolation you might well come to the conclusion that you should not invest. You need to look at what is put in front of you and see the objectives of the scheme. This particular scheme is to devise new mining technologies that would reduce the amount of water used for mining extraction, reduce the environmental impact and maintain the gross margin in mining because they are very small. The consideration would be that overall if those objectives could be achieved that would be a good thing to happen, and if it requires some public funding to catalyse that process in some cases you would say, ‘Yes, that’s a good thing to do.’ In other cases you would say, ‘A cost-benefit analysis will probably mean that, no, we as the public decline that invitation to co-invest.’

**Dr Arthur**—Also in terms of the overall economy, we have certainly made a stab at trying to get some of those figures in a thing called a balanced scorecard, which appears in the Annual Innovation Report. This contains a lot of numbers; certainly it can be improved but I think it is a very interesting attempt to provide, year-on-year, some kind of scorecard—as the name suggests—as to how Australia as a system is doing in terms of its promotion of innovation and the distribution it effects through the economy.

**CHAIR**—Can I just come back to your point about the shift from people doing the basic research and doing the applying. Are they actually the same people?

**Dr Walker**—Not everybody, of course.

**CHAIR**—No; but essentially, if they are not geniuses from those institutions that follow the science through to the application, are they the people who generate the science?

**Dr Walker**—Yes, they are in many cases. I think you can find many examples of that.

**Prof. Hoj**—There will be cases where it is probably not in the national interest to force everyone to operate across the continuum. There might be some people who are so gifted at unearthing new knowledge that you would be crazy to force them. It is the system that has to deliver.

**CHAIR**—We are not forcing them. We are not forcing anybody; it is just that they are now autonomously choosing to go down that path.

**Dr WASHER**—There was a fairly simple question that I think someone has answered. Basically, if you go into a university you are looking at quality scientific research. How do we assess that? If it is on cutting edge technology—say like nanotech, gravity waves or some new technology—we do not have peer-review groups in that field. Even internationally there is a problem. We have to reward those universities according to the quality of the research, but if it is genuine, brand new research, how the heck can we monitor that?

**Dr Arthur**—There is no magic solution to that. We have no better mechanism than peer or expert review, and occasionally that fails us. The classical example of that failure recently is the

recent Nobel Prizes in medicine, where if you had carried out any kind of expert review either on quality or impact within a short time frame after the research was done, that research would have scored very badly because the peers—incorrectly—thought it was wrong. But in any particular system you will always have the outliers. What we do know from the history of our involvement is that there is no better mechanism out there than asking people who are also experts in the field to assess the quality of research and to trust their human judgment.

**Prof. Hoj**—I think that is absolutely correct. You could probably accuse the peer-review system of having a certain degree of conservatism to it. What that means is that you are very unlikely to waste your money. It will go on something that is viewed to be close to the cutting edge. But you probably have to also allow your system to run a bit of risk. If you have a gut feeling that this looks right but nobody is prepared to say it, you should be able to put a small piece of your dough in that direction. That comes into accountabilities and an understanding that this is required, because otherwise you will actually run into the situation that you and Evan have outlined.

**Dr Arthur**—The history of it is that the intellectual science community has got a reasonable track record of balancing that off. Einsteins do come along and their discoveries, which do fundamentally change paradigms, are recognised—in most parts—appropriately and within reasonable time frames. In any case, as I said, there is nothing that you can replace that with, by definition.

**CHAIR**—Thank you very much. It has been very illuminating. We will come back to you with some questions. You said that there was some material coming through on a progression from the basic science through to the innovation. If that was happening, that would be really interesting. Just provide us with whatever you can; we are not going to die if we do not have it, but it would be nice. I would also be interested in anything that you could advise as worthwhile reading on the British experience.

**Dr Arthur**—We can certainly provide some material.

**CHAIR**—Thank you very much. We will be back.

[5.35 pm]

**ALLNUTT, Mr Philip, General Manager, ICT Industry Branch, Department of Communications, Information Technology and the Arts**

**BESGROVE, Mr Keith, Chief General Manager, Information Economy Division, Department of Communications, Information Technology and the Arts**

**BOLDEMAN, Dr Lee, Manager, Information Economy Section, Department of Communications, Information Technology and the Arts**

**CHAIR**—Welcome and thank you for coming. The committee does not require that you give evidence under oath, but this hearing is part of the process of the parliament and deserves the respect that the proceedings of the House would have. It is customary to remind witnesses that giving false or misleading evidence, especially on sensitive issues—as some scientific issues are—may be regarded as contempt of the parliament. Would you like to make an opening statement, or add to or subtract from your submission?

**Mr Besgrove**—I do have an opening statement. I would also like to flag with the committee that there is an issue which we did not mention in our submission which may be of interest to the committee. That is that DCITA has been conducting, over the last eight or nine months, a review of business angel activity in Australia, which I think would be of direct interest as it fits into the provision of early stage equity capital, particularly for commercialisation. So, with your forbearance, I will make the opening statement, talk a little bit about the business angel activity and then open it up to questions on the submission, or anything else you wish to raise.

First of all, to cover DCITA's involvement in innovation policy: as indicated in our submission, DCITA has responsibility for a wide range of issues which impinge on innovation in the Australian economy. In particular, DCITA has responsibility for information economy and ICT industry development issues. The department has a strong interest in the rapid development and pervasive influence of ICT as a general purpose set of technologies in enabling economic and social development. Consequently, DCITA has been an active contributor to innovation policy and was heavily involved in the development of both BAA 1 and BAA 2. It is fair to say that DCITA usually ends up with only a very small amount of the program money but we often get involved in a lot of the policy development process, and our minister has been one of the key ministers involved in developing both of those packages. Consequently, we are very interested in innovation policy in general.

We have also undertaken substantial research into the nature of the innovation system and the impact of ICT on productivity and economic growth in Australia. ICT, broadly defined, plays a central role underpinning economic activity in general and in enabling innovation in particular. ICT plays this central role because it is radically improving our capacity to collect, analyse, utilise, distribute and exchange information and to organise economic and social activities—abilities that underlie all human activity. So at least part of our interest is in the pervasive nature of the technology and the manner in which it is transforming basically every aspect of Australian society.

Australia's continued ability to harness the power of the information economy will significantly influence its long-term economic prosperity, international competitiveness and the ability to innovate. Consequently, it is important that key policy makers and opinion leaders have a sophisticated understanding of Australia's innovation system in general, and of the very positive influence that ICT is exerting through our society in particular.

Australia is sometimes cited as a country where the contribution of ICT to productivity growth has been overshadowed by other influences; in particular, microeconomic reform tends to be talked about a great deal. We have commissioned a whole lot of research trying to better understand that. I will not go through the details of that other than to say it involved some in-house macroeconomic studies, some international consultancies using leading economic researchers from around the world, and some additional in-house papers.

The main thing to take away from all of that research is that these technologies have been much more important in driving Australia's productivity growth over the last two decades than has previously been suspected. It is very clear that microeconomic reform was very important in creating the competitive circumstances that encouraged companies to take up new technology. But it is equally clear that, once that happened, it was the uptake of new technology, and particularly its diffusion across the Australian economy through a whole range of applied innovations, which have been profoundly important. It is also clear from that work that you can measure quite clearly evidence of the spill-overs from those technologies across the economy. We would be happy to supply more details on that if the committee was interested.

Just to summarise our feelings about the innovation system: in our submission we have provided a brief outline of what we think is meant by a national innovation system, drawing on a wide range of innovation literature. We have also contributed to research undertaken by the National Graduate School of Management at the ANU. In part, that research has used a series of case studies to throw light on the drivers of innovation and change in Australia over the last 20 years and on what shapes the emergence of new sectors in Australia. That research indicates that Australia has a very conservative innovation system—you were talking to our colleagues from DEST about that only a moment ago—which promotes comparatively little structural change, but which is focused on what NGSM call 'systems integration'. By this they mean we tend to import our core technology and we use sophisticated problem solving skills to apply this technology. In addition, they suggest that much of our innovation involves process rather than product innovation; which, again, is relevant to the earlier discussion about the mining industry, for example.

To the extent that structural change may be important in the long run, this research points to the need for a long-term perspective and patience in building the capabilities for that structural change, which goes back to the discussion about the need to provide funding for basic research and quite concerted government activity in that space. This perspective also points to the prime importance of creating the capacity to absorb technologies developed elsewhere. This is a prime important goal of our educational and R&D investment. Thus, when we talk about the importance of commercialising Australian technology, we need to be conscious that this might not involve product innovation but rather the successful implementation of process innovations. This reinforces the emphasis that DCITA is placing on the significance of ICT, but we would suggest that other general purpose technologies, like biotechnology and nanotechnology, are equally important to Australia's future prosperity.



As a result of our experience, we suggest that there is also a need for more concentrated effort in researching the national innovation system within Australia and regional innovation systems across Australia. The bottom line from where we see it is that we would support the broad thrust of the existing investment in the innovation system in Australia. Our concern is that commentators do not always take account of process innovation and also do not necessarily focus enough on applied research and, in particular, the important role of technology diffusion. I think the sorts of innovations which take place in the banking and financial industry in Australia are a very good example. Very little of that would attract ARC funding but it is, in fact, a very important set of innovations which have often been very successfully commercialised to the benefit of the Australian economy. We are coming at this with a somewhat different perspective to our colleagues in other departments.

**CHAIR**—Can you just elaborate a bit more on process innovation. What distinguishes it?

**Mr Besgrove**—I might ask Dr Boldeman to respond to this as well, since Dr Boldeman is to blame for much of the research that we have been doing on these economic impacts. I guess a good example is when you look at industries like banking, financial services and insurance, where the underlying technology has seldom been developed in Australia, although some elements have been. What you have occurring in those sectors is people taking a base technology which has been developed by in many cases a Japanese or an American company and then applying it to a particular problem to come up with new services or new ways of doing things and in the process of doing that developing completely new banking services and changing the nature of the products. If you think about the way you interact with banks over the last two decades, there is actually a much larger range of things you can do with them now compared with 20 years ago. A lot of those innovations have occurred within Australia. Australia has been a leader in, for example, using things like automatic teller machines. The underlying technology was developed elsewhere, but the application of them and the use of them in range of different applications is very much an Australian innovation. It is that sort of thing we have in mind. Do you want to add to that?

**Dr Boldeman**—There is a normal distinction made in the innovation literature between process and product. People tend to think of product innovation because it is the thing we see most commonly when we go and buy IT goods, a new DVD player or a plasma screen. We tend to think that that is what it is all about. They are a very important part of the sorts of innovations that come out of Japan, Korea, Taiwan and the United States. Some of the innovation literature emphasises that the United States innovation system is quite different from that of Germany, which is a country which is about manufacturing goods. They put an enormous amount of effort into things like chemical engineering and that sort of thing. Their national innovation system is really focused on how to produce process innovation. Australia is a little bit like Germany in that respect. We talked about agriculture earlier and the success of the wine industry, where you have this combination of new technology for making high-quality wine combined with really good quality grapes—and with a market opportunity. So you have this complex interaction of factors, but ultimately much of our innovation in Australia, particularly in the mining industry and in agriculture, is all about how to improve our production processes rather than how to change the product itself.

**CHAIR**—Does that mean that the people who invented the automatic teller machine do not use them as widely or as effectively as we do?

**Mr Besgrove**—I think the base technology was developed elsewhere. The application of them, including the sophisticated application of them, is something that Australia has been a world leader in. It is not the only country that has led the way in that area. In the process some Australian companies emerged that have been successful in the commercialisation of some aspects of that. I was using it as an illustration of where the core technology came from somewhere else.

**CHAIR**—No, that is fine—I get very literal sometimes.

**Dr Boldeman**—The point really is that it is a whole system that has been created. Okay, it is nice to have an automatic teller machine but unless it is connected to all the other back office systems then it is useless to you. It is the creation of that system that ICT enables. ICT has been central in altering business systems and enabling innovation in business systems. When we talk about innovation in general we seem to forget that in fact it is the business systems themselves. The factory system itself was at some stage an invention. So you have this accumulating capacity. I think we have been really very good at these sorts of process innovations in the service industries.

**Mr QUICK**—So in the area of telemedicine and telehealth are we a process or a product innovator in Australia?

**Mr Besgrove**—I think it is fair to say that we are a little bit of both but that the big pay-offs will be in the process. In the area of telemedicine many of the technologies are already in existence and could be applied. The real process innovations which need to occur for telemedicine in Australia have to do with the health and hospital systems and the interaction between those elements.

One of the other hats I wear is that of chair of the National Broadband Strategy Implementation Group, and I have a lot to do with broadband program policy across Australia. The technology is already well developed for telemedicine; what is missing is acceptance by the hospitals, the pharmacies, general practice, the specialists and the interoperability standards.

**Mr QUICK**—And the health department.

**Mr Besgrove**—No, I actually believe the health department is working very effectively in this space and we work very closely with them.

**Mr QUICK**—From one of the other committee inquiries in which I have been involved, I learnt that there is not a doctor prescriber number if you are, say, in Broome and talking to a specialist in Adelaide. I think the department had to change some of the schedules in order to accommodate the innovative telehealth stuff.

**Mr Besgrove**—I agree. But if you talk to the Department of Health and Ageing about what their broadband for health program is about, you will find it has a focus on technology, but it is mostly about cultural change within and between the players that needs to be underpinned by standards for interoperability, and there is no agreement on the standards today. There are a number of mundane things to get through and then the technology that already exists can be applied. Chair, I apologise: it is a hobby horse of mine.

**CHAIR**—We will come back to that in a moment.

**Dr WASHER**—Dr Boldeman, you alluded to the fact that we have been classified as being the lowest in business investment in R&D amongst OECD countries. Yet when you look at our businesses in Australia —mining, agriculture and the number of small to medium enterprise companies—compared to some countries that would be classified as having a much greater R&D investment in business, you see that we are in fact a very successful country. What I am proposing to you—and I think you hit the nail on the head in this regard—is that we may not develop the widgets but we certainly get around to using them in innovative ways and we value add to our businesses. I make the comparison with Sweden and Denmark. Things are not looking so good in Europe: innovation and lateral thinking are there but not to the same extent as it is in Australia. Have there been any comparative studies done to look at that aspect of it?

**Dr Boldeman**—No, we have not done comparative studies of the innovation system. We are currently doing some comparative work in respect of the productivity growth from ICT across Australia, the United States and Japan. That is very difficult stuff and I would not bet my arm on the results of it. Taking the broader question, I draw your attention to people like Keith Smith and Jonathan West, who made a submission to this inquiry. Keith Smith is quite an expert on Finland, and he has a really interesting story to tell about how the Finns were in desperate trouble and how they actually turned their economy around in a 10-year period. They put in an enormous amount of investment into R&D and all the associated programs that support small business formation and the take-up of R&D. The consequence is that there has been an astounding amount of new technology developed. In effect, Finland has moved from the sort of standard that we had in terms of our R&D spend—that is, the private R&D spend—up to being at the top of the table. Their spend on R&D has been enormous. Their experience suggests that that can play quite well in economies that are not that dissimilar from our own. Similarly, the Irish have done a fair bit of investment. We don't perhaps study these economies as well as we might, but then we cannot study everything. But there is a lot of international learning that we might derive from it.

**CHAIR**—I want to get back to the banks, because I like the example and I can deal with it. Where do these organisational innovations, if I can put it that way, figure in our measurement systems?

**Mr Besgrove**—Frequently, they do not. They would not figure in measurements of business expenditure on R&D, for example, because they would not be classified as research and development. Dr Boldeman and I have been involved in innovation issues both in this department and in DITR for as long as either of us can remember, and one of our ongoing concerns is that so much of the innovation of the services sector—remembering that the services sector is very large in the Australian economy—does not really get captured because it is not seen as a traditional form of innovation—because it is not; it is different.

**CHAIR**—What is the consequence if it is not seen but it is done?

**Mr Besgrove**—It is not credited.

**CHAIR**—Does that matter, so long as it is done?

**Mr Besgrove**—For large companies that can clearly access market response to it, that probably does not matter. For smaller companies that are trying to become established, that have process innovations which could have a large commercial pay-off, I believe they face as difficult a climate as your classic R&D companies.

**CHAIR**—Is that because we do not give them money or we do not give them assistance? How does that work?

**Mr Besgrove**—They face similar difficulties in gathering early-stage finance as more traditional product innovators would. In some cases the difficulties may be greater, because the take-up of a process innovation frequently has to be supported by a large services company before it has any credibility in the marketplace. So they are significant hurdles.

**CHAIR**—I understand.

**Mr QUICK**—You mentioned Finland. As an ex-teacher, the Finnish education system seems to me to be of the highest standard, where people with a TE score of 100 out of 100 become teachers, rather than doctors, as we have in the Australian system, where, with 75, you become a teacher. The thing that worries me is that we are talking about innovation and R&D, yet the evidence seems to be that in our high schools we have a lack of fully qualified or specialist maths and science teachers. Is there any evidence that—

**Mr Besgrove**—Perhaps I could respond to that. We have not looked specifically at that issue per se. That is something that we know DEST has been looking at. We are looking at issues to do with skill shortages and emerging skill shortages in relation to the IT sector across Australia. It is quite clear that there are some significant emerging issues to do with potential shortages of IT skills. While I cannot comment on the school system, certainly in the university system there are emerging dangers of an undersupply of teachers, because what tends to happen is that that industry overshoots and undershoots all the time. We have had reductions in enrolment in Australia's universities and TAFEs for the last three years. Enrolment has been going down by about 20 per cent per annum for three years. That is now playing out as a reduction in demand for teachers in those two systems, just at a time when it appears that demand is about to pick up again. So one of the problems with the education system for technology areas is this sort of recurring problem of undersupply and oversupply.

**Mr QUICK**—So is it easier for banks to go and buy the technology rather than take on university graduates in that IT area?

**Mr Besgrove**—It is complex. Like everything to do with innovation, it is difficult to describe in a few sentences. Clearly, the banks have a strong interest in doing both, but it is also clearly the case that Australia's banks have put quite a bit of energy into developing new product lines which they can then use as a basis for their own competitiveness.

**Mr QUICK**—Is there any evidence that the four big banks are taking on fewer university graduates?

**Mr Besgrove**—Quite the contrary.

**Mr QUICK**—They are taking on more?

**Mr Besgrove**—There is growing evidence that the demand for IT professionals is growing outside the ICT industry and has in fact shrunk somewhat in the last couple of years within the traditional ICT industry. So it is becoming a very complex picture and an increasingly difficult one to predict.

**Mr QUICK**—Is that just an Australian phenomenon?

**Mr Besgrove**—No, I do not believe so.

**CHAIR**—I have two quick questions. Getting back to the nonfunding of process innovation: what should we be doing?

**Mr Besgrove**—It is not the case that process innovation is not funded.

**CHAIR**—Sorry; the inadequate recognition—

**Mr Besgrove**—The AusIndustry programs, for example, clearly have provided a lot of support over the years to a range of process innovations. Certainly in mining in particular I can remember a whole range of them. So it is not the case that we do not fund them. I think DCITA's concern is that there is not really a lot of recognition about how important to the Australian economy process innovation really is. I believe it tends to get less focus within media commentary and within people's minds.

**CHAIR**—Yes, but then we get back to the question: if it is happening, does that matter?

**Mr Besgrove**—We believe it does matter to some extent. We believe that if it had greater national consciousness then we might celebrate it more than we do. If you celebrate something then it tends to be copied, it tends to be followed, it tends to be regarded as more valuable. It is from that perspective that we think at least some emphasis should be put on it. In a similar fashion, technology diffusion has the potential to be profoundly important and has already been profoundly important. It is not the case that governments ignore technology diffusion, but it is certainly not top of mind. When people talk about what government should do about innovation, it tends to be a lower level priority.

**Dr Boldeman**—It is an interesting contrast between ourselves and Taiwan or Singapore—or quite a number of other countries, in fact; Ireland, Finland even—where the focus is heavily on what can be commercialised. What can we get from somewhere else that complements our existing capabilities? How do we feed it into our economy? How do we create the capability? Taiwan in particular is very much about a focused effort on transferring technologies from overseas.

**CHAIR**—You mentioned business angels when you started.

**Mr Besgrove**—Yes. I presume you are concluding fairly shortly?

**CHAIR**—Yes. Have you published anything, or are you on the verge of publishing something?

**Mr Besgrove**—We are on the verge of reporting to the minister. I cannot talk about the nature of the recommendations, but I can give you a quick overview of what we have found. It is clear that around the Western world in particular, business angel activity is at least as important as a source of private equity capital as the traditional venture capital market. In the United States, it is actually much larger than the venture capital market. Angels play a very important role in the early process of commercialisation of technologies in most countries. There is very little study in Australia of how many of them there are. We believe there are probably several thousand high net worth individuals in this country performing some form of business angel activity, but it is impossible to more accurate than that. We have met a number of them; we have heard of hundreds of them in various parts of the country, including Canberra.

We have looked a lot of overseas government activity and a lot of overseas analysis, because there is so little that has been done in Australia, and several things stand out. If you can get business angels together into loose confederations, luncheon clubs, syndicates, whatever you like to call them, they will tend to see more deals, better deals, get better terms, are more likely to make successful investments and are more likely to make successful follow on investments—all of which is in the interests of the people with the small technology company looking for the money. So there is a virtuous circle there if you can find ways to enhance the syndication of those people.

It is not an easy thing to do. As you can imagine, these people have very large egos and they are not readily amenable to organisation, particularly by government. So the organisation needs to be done at arm's length. As a general rule, DCITA does many programs—and my colleague Mr Allnutt is responsible for a number of our programs—that provide support to ICT companies at arm's length from government. The incubator program is a good case in point.

That is where we are at. We are starting to frame some proposals to government about things it might like to consider, which may be considered at the same time as the DITA review of venture capital. We are not entirely sure if the two will happen side by side, but it would be good if they could be. It seems to us that there are some things that government could do that could enhance the availability and, more importantly, the success rate of business angels in Australia.

**CHAIR**—Thank you very much; that was very interesting. I am sorry—you are probably not sorry—but we do have to wind it up, because we are about to lose our quorum.

**Mr Besgrove**—No, we can talk about this all day.

**CHAIR**—We will come back to you over it.

**Mr QUICK**—Can I ask Dr Boldeman some questions? The change in Finland, was that a national government change in conjunction with industry, or was there a general national consensus saying, 'We're about to go belly up'?

**Dr Boldeman**—No, they were in desperate trouble. They were going belly up. It is a communitarian society, so they all do pull together in a way that we find difficult. Yes, it was a national effort led by a government, but with—

**Mr Besgrove**—It is important to understand that there are some important differences between the two countries. There are only five million of them, they are culturally homogenous and their economy was in desperate trouble, so they had to pull together in a very clear direction. We would seldom face such a dark national scenario as what they were facing 15 years ago.

**Mr QUICK**—How do we compare with Canada? They are basically the same sort of population size and their land area is greater. How do they compare to us with some of the broadband stuff and IT technologies?

**Mr Besgrove**—Generally speaking, the Canadians and us tend to cross-inform each other pretty regularly. Certainly in relation to broadband we tend to, if you like, leapfrog each other in our approaches. Many of the things the Canadians and the Australians, and the provinces and the Australian states, do tend to replicate each other. You heard from our colleagues from DEST earlier. One of their great success stories is the development of the Australian Research Network over the last year or so. That is a major broadband link between all Australian universities. It drew at least some of its inspiration from the Canadian Canary program and is now providing a level of productivity superior to that of the Canadian system. The two are comparing notes all the time. We like to use the Canadians as examples of what is feasible in a country like Australia because there are some significant similarities. We do spend a lot of time comparing notes with the Canadians.

**Mr QUICK**—Businesses are tending to go to India—that seems to be the emerging IT place. Is there any information we can bone up on to see why they are doing what they are doing, why we are setting up call centres there and why they seem to be the IT experts?

**Mr Allnutt**—It certainly is the case that a number of Australian companies are outsourcing work to India. The ANZ Bank is an example that has been in the news recently. The ANZ has investments in India, where it is having some of its work outsourced. But it is a two-way street. Indian companies themselves are now investing in Australia. For example, in the case of the ANZ, they are increasing their employment in Australia to do the other services which can now be provided to their customers, which they could not do if they could not get them done more cheaply in India. So it is certainly very much a two-way exercise.

**Mr Besgrove**—In our work on skills, we have looked quite extensively at the issue of the net gains and losses in the IT sector over the years. Australia has always been a net importer of IT skills, and that is still the case. So, yes, some jobs may have gone to India, but other jobs have come to Australia. Australia has been a beneficiary of outsourcing from other countries over the years.

**CHAIR**—Thank you very much. That was very interesting. We will get back to you on a couple of things that I would like to pursue. Can somebody move that the publication of evidence be authorised?

Resolved (on motion by **Mr Tollner**):

That this committee authorises publication, including publication on the parliamentary database, of the transcript of the evidence given before it at public hearing this day.

**Committee adjourned at 6.06 pm**