*****CHECK AGAINST DELIVERY*****

CHIEF SCIENTIST

TERTIARY EDUCATION FACILITIES MANAGEMENT ASSOCIATION - ANNUAL DIRECTOR'S FORUM

RMIT UNIVERSITY

MELBOURNE

30 JUNE 2012

Thank you for the invitation to address your annual forum.

I can see a number of familiar faces around the room: people with whom I've shared the battlefield in a former life, people with whom I have shared common goals - the teaching, learning and research delivered by the various universities in which I have been privileged to work.

Our roles have always been strategic, and always directed at doing more with less, that is, getting the best possible results from the investments we have made.

As Australia's Chief Scientist I have taken a step further back from the coal face, if that isn't a politically incorrect idiom in today's carbon constrained world.

That gives me the luxury of taking an even broader view and the occasional opportunity to place a counselling hand on a shoulder if I feel it necessary.

Well, that's probably a bit stylised and sounds a bit heavier than the reality, but my role as Chief Scientist is to cast my

eyes globally, to compare and measure and, if needed, to praise and admonish as I think it appropriate.

Today, I want to continue some of the themes that I have taken recently.

So to work backwards a little from most recent events, I want to talk about the Health of Australian Science report and what it has shown us.

The Health of Australian Science report was the culmination of eight months of very focussed work by people in my office.

It grew out of a recognition that to be an effective advocate for science in the broadest sense as Chief Scientist, I needed to go back to scientific basics and amass some empirical data.

Calling the report a snapshot doesn’t come anywhere close to doing justice to the hours of work by my office.

Notwithstanding that, it is most comprehensive.

Unfortunately, there are gaps, because of a lack of data, though not for want of effort I hasten to add.

And as they always say, there is the good news, and there is the not so good news.

At the risk of repeating what you have already read or heard before, from many perspectives Australian science is in reasonably good shape.

We produce well trained, well educated and knowledgeable graduates in a broad range of disciplines.

To use an apt sporting metaphor, we punch above our weight when it comes to international research, with 3 per cent of the world's published research from 0.3 per cent of the world's population.

And we have a Government that is committed to ensuring we have excellent teaching and research facilities through its investment from the Education Investment Fund.

However there's no room for complacency.

The outlook, as the weather people say, is cloudy, even – dare I say - gloomy in some areas.

Somehow we are raising a generation that seems to have lost their connection with the wonders of science.

They are not engaged, despite having access to and making use of its outputs in a myriad of applications every day.

It's a generation that seems to be happy to take X-Boxes and PlayStations, smart phones, wireless for granted, without any meaningful reflection about the science and maths and engineering that brought them to existence.

It concerns me greatly that attitudinal studies taken last year show students have an almost perverse view of science.

For example, 60 per cent of year 11/12 students not studying science thought science was ‘never’ or only ‘sometimes’ useful in everyday life, while only 4 per cent thought science was ‘almost always’ useful.

The attitudes of students actually taking science subjects are probably even more disconcerting, after all, they have chosen science: only 19 per cent thought science was ‘almost always’ useful in their everyday lives – you have to wonder about their powers of observation and deduction!

And only 33 per cent thought science was ‘almost always’ useful to their future.

I can’t say I take much comfort from the fact that only 9 per cent thought science would never be relevant to their future.

I said that the Health of Australian Science report had good news and some not so good news.

The not so good news is that Australian science has a number of areas in which our capacity is vulnerable.

And given the attitudes to science of those year 11/12 students in 2011, clearly we have a number of areas to address.

Chief among these is the risk that we are losing scientific capacity and, to a large degree, I think this can be attributed to those students' perceptions about the value and importance of science.

It has translated into a steady decline in the numbers of students choosing a major in the enabling sciences, chemistry, physics and mathematics since the 1990s.

This has ramifications for both Australia and the global economy into the future because the enabling sciences underpin many of the professions and trades that will find

solutions to or simply manage the problems that we Australians and the world face.

I suspect I won't get too much of an argument, because I’m sure that every good facilities manager here has a good handle on science and technology, and I’d be surprised if anyone would argue against the notion that the Science, Mathematics and Engineering fields provide the basis for building a constructed world that improves the lot of human kind.

…Or that at the very least that science and technology needs to thrive for the knowledge and understanding and benefits it brings, even though not everyone needs to be a scientist or a technologist.

The decline in enrolments of students in the science, technology, engineering and mathematics – or STEM disciplines - should be a cause for concern because it represents a decline in our stock of scientific skills.

The decline in what has been given the shorthand title of the STEM disciplines is measurable, both in Australia and in many parts of the world.

This is being noticed.

I was gratified that the Australian Government has already responded to some of recommendations we made in our report - *Mathematics, Engineering and Science in the National Interest*.

This year's budget allocated $54 million to begin to address issues related to training teachers and inspiring students to a greater interest in the area.

We need to be technologically savvy as a nation because we need the scientific and technological nous to not only maintain our 3 per cent contribution to world knowledge, but to interpret and adapt the other 97 per cent to Australia's benefit.

In the United States, there's a top-down interest in the decline in STEM enrolments with President Obama expressing concern on simple economic grounds: *American students will move from the middle to the top of the pack in science and math over the next decade. For we know that the nation that out-educates us today will out compete us tomorrow.*

His advisory council on science and technology has urged a radical rethink of the national approach, saying that the United States needs to produce one million additional graduates in the STEM disciplines over the next 10 years to maintain US pre-eminence in science and technology.

A number of countries, notably in Asia, have made concerted efforts to create scientifically and technologically literate societies, and are now decades ahead of us.

In an era where South Korea has had to develop new words to the lexicon as it developed a modern scientifically literate society post war, other nations are taking notice of what is occurring there, and in Singapore, Hong Kong and mainland China.

Taking notice began over a decade ago when Education Ministers in the Eurozone identified a need for growth in the STEM disciplines to foster a *'dynamic and innovative knowledge-based economy.'*

In Australia, where the national agenda is about transforming traditional industries to become more innovative and competitive in a low carbon global economy, it does not augur well that we lag behind the international average in the ratio of students taking STEM compared with those in the non-STEM degrees.

Internationally in 2002 the ratio was 26.4 per cent, however in Australia it has barely budged from 16.1 per cent in the decade since.

Investing in science and technology is an investment in Australia's relationship with the rest of the world, and in our continuing prosperity.

At a most basic domestic level, a scientifically literate citizenry means a citizenry that is empowered them to make well-reasoned life choices.

The Australian Government has argued that we need to transform Australian industry by growing innovation and productivity to ensure our economy remains internationally competitive and we continue to enjoy a high living standard.

Investing in mathematics, engineering and science is integral to this.

Just as a paradigm shift is being advocated in the United States, we need to consider quite dramatic action to avoid becoming a net importer of knowledge and skills.

The only brake on importing knowledge and skills is the question of whether we will find anyone available, given that the international climate will place a premium on such skills and the competition for the best will be fierce.

Uncapping the number of university undergraduate places is a significant step towards addressing this.

And yet the massive expansion of the higher education system has not translated to growth in the enabling sciences.

However, that old saying about taking horses to water still holds because I don’t think we can compel people to take particular courses, we can only rely on better arguments and incentives.

More specifically, in 2010, only 13 per cent of teaching at second or third year levels of a BSc or similar degree was for mathematics, 10 per cent was in chemistry and 5 per cent was in physics. Hold these numbers because I'll come back to them again.

Compare this with the expansion that has occurred in higher education over the past 20 years or so.

So uncapping university places won’t solve this looming shortfall alone.

Neither did tinkering with the level of HECS fees in certain disciplines.

So what to do?

For a start, scientists need to sell science more effectively.

Scientists are not cutting through the clutter and the chatter and in many cases are under outright attack.

Talk is cheap, and it's easy to distort the arguments. There are plenty of charlatans around ready to spruik spurious and poorly informed scientific views.

And, sadly, not all the chatterers are being called to account quite in the same way as 2GB's Alan Jones has just been for his remarks broadcast just over a year ago that: *Human beings produce .001 per cent of carbon dioxide in the air*.

The Australian Communications Media Authority found he'd breached the code of practice when he made no effort to check the veracity of his claims.[1]

Testing the veracity of ideas is at the basis of scientific endeavour but scientists, many of them working with the best of motives, need to be alert to the potential for conflicts of interests.

[1] http://www.acma.gov.au/WEB/STANDARD/pc=PC_410398

Unfortunately, even the slightest hint of a conflict opens scientists to accusations of bending to pressure, whether it is political or commercial, and gives rise to claims their outcomes are tainted.

So with an ever questioning public we need to be above reproach.

And we need to be ready to point out at any opportunity the difference between science and pseudo-science.

For every scientist who is wary of venturing outside their area of expertise, the public debate can be distorted by three or four who have no such scruples.

Good science along with other academic endeavour is validated by peer review and with the greatest of respect few of the regular media commentators meet the standard.

Communicating science well is only a part of the problem.

I want to revisit some of the ground I have traversed in recent speeches because it gives context to my conclusion.

As facilities managers you will be well acquainted with how funding priorities are set.

So it is a little alarming that funding in a range of areas from facilities to research at universities, is influenced by the choices students make about subjects at the tender ages of 14, 15 and 16, as they venture into senior secondary levels.

I want to then just remind you of the statistics about teaching in second and third years of BSc and equivalent, I mentioned a few moments ago.

Funding for all manner of resources is driven by the pattern of enrolments by undergraduate students and their study choices.

It's a simple matter of counting the beans; fewer students means less Commonwealth funding which eventually means fewer staff which means less research and, ultimately, less innovation.

It snowballs; less research means less postgraduate candidates, less completing postgraduates means fewer staff and the cycle of fewer students, less research and less innovation continues.

Several areas have reached critical points, statistics is one, agriculture is another.

Agriculture is an integral part of Australia's foreign policy, so, all of a sudden, a decline in enrolments in agricultural science has foreign policy implications, and not just on Australian food producers.

The risk of long term decline of numbers in any discipline is that the population of future research leaders and teachers becomes non-sustaining.

So back to our teenagers making subject choices that may very well influence national prosperity.

The Relevance of Science Education program in Norway asked 15 year olds in more than 40 countries about their attitudes to science and technology.

While the 40 countries did not include Australia, the results showed that the more developed a country, the less young people tended to choose mathematics, science and technology as education paths and as a career.

The research concluded that today's youth make choices based on the concept of *who they will be*, rather than *what they will do*, rather than altruism about what is good for the national interest or making a good salary.

And this may be reflected in the attitudes about their choices, with researchers concluding that *it might be that we have now passed the era in which the work of physicists, technicians and engineers is seen as crucial to*

people's lives and well-being, in other words, that science and its benefits are well and truly taken for granted in developed countries.

In Australia, as in other developed countries, high school students don't seem interested in doing science or advanced mathematics in high school.

The proportion of enrolments in these disciplines in Year 12 continues to decrease.

Year 12 enrolments in science vary around the country, however, in 2010 51 per cent or 110,328 took a science subject or subjects, including psychology.

On the face of it, the fact that 72 per cent of the 153,512 student cohort in 2010 took a year 12 maths subject appears healthy.

Drill down and you find that the majority of these, more than half were enrolled in 'elementary' rather than the

'advanced' or 'intermediate' courses that are prerequisites for certain university courses.

As I said earlier, the community's disinterest in science is a matter for concern, even though it is prepared to take advantage of scientific outcomes every day.

We need to recruit our scientists and our scientifically literate from an early age.

As Chief Scientist, I am probably unique in one sense, because my interest in science developed over years of curiosity and was not piqued by a light bulb moment in a classroom.

Having an inbuilt ‘why is it so?’ attitude is probably a rare genetic condition, so we need instead to apply a little fertilizer to awaken the latent thirst for understanding.

Breeding inspiring teachers and giving students experiences that give real life context to chemistry’s periodic tables will help.

Doing more to sell the benefits of a life in science will help.

I think the Australian Government has taken the first steps towards this with the allocation of $54 million to enhancing the quality of science and mathematics education in the Federal Budget.

This spending will give effect to the notion that mathematics and science can be made interesting and accessible without dumbing it down.

And, just as there are programs designed to translate science and research into industry by placing scientists and researchers in the same room as industrialists, we can use the same realities for our future researchers and scientists.

It would be nice to confidently predict that you should start planning new labs at your universities in 10 to 15 years time.

We will see how it unfolds.

I will say that having governments that are receptive to investing in research will add further to the impetus for

I know that you have particularly expressed interest in the Education Investment Fund, but I would argue that the big picture also includes other investments.

First though, the Education Investment Fund, which is one of the Australian Government's three nation building funds, with the Building Australia Fund and the Health and Hospitals Fund.

It established a dedicated system for funding projects that create significant infrastructure in higher education institutions, research institutions and for vocational education and training providers.

So far, since January 2009, it's committed $4.6 billion towards major infrastructure projects across the three sectors.

I know a number of Government Ministers have talked about finding solutions to national and global challenges.

The fund seeks to:

- transform our knowledge generation and teaching capabilities,
- boost participation in tertiary education,
- position us to meet domestic skills needs now and into the future,
- enhance Australia's innovation capacity,
- revitalise the growth of Australia's research capabilities, and
- enhance our international competitiveness in education and research.

Recognising the needs of regional Australia, the government has embarked on a funding round dedicated

to support regional higher education and vocational institutions.

The EIF Advisory Board is considering applications received as a part of stage 2 of the Regional Priorities Round and, while I would love to say more, the Australian Government is expected to announce the outcomes later in the year so I can't.

Needless to say, the EIF and associated shorter infrastructure initiatives like the one-off Better Universities Renewal Fund and Teaching and Learning Capital Fund for Higher Education programs are welcome additions to the higher education, skills and research landscape.

In the higher education space, the EIF has meant that the Australian Government has been able to partner with universities to make quite significant investments possible.

Some of these investments open our doors to research aimed at global issues.

The successful projects, I think, are a testament to how good planning between the research arm and facilities arms of Australian universities will lead to long term outcomes.

It is significant that in a time of budgetary constraint, the Australian Government was able to boost university funding for science and research by more than $126 million this financial year.

I'm sure that it's worth reminding you that in times of tight budgets investment in research and research infrastructure will be scrutinised very carefully.

Despite some uncertainties about the future of some programs, it is still important to plan facilities develop around the 19 priority research infrastructure areas

identified in the Government's Strategic Roadmap for Australian Research Infrastructure released last year.

This is the plan for investment and coordination to around 10 years out.

The roadmap spells out the view of the research community about its needs and helps make the case for investment.

Whatever the views of individual institutions might be, the roadmap envisages national and international scale collaboration so that funded infrastructure is pooled for use by researchers regardless of where they came from.

A holistic approach has to be far more effective because economics and capturing economies of scale will be prime considerations for funding decisions of the future.

And in the spirit of fostering collaboration, co-investment will be viewed favourably as will value-for-money.

A number of other points need to be remembered.

It's one thing to invest in infrastructure but management arrangements need to be equitable, transparent and attribute costs accordingly and appropriately.

These are some of the principals that will guide the new Australian Research Committee that was formed by the Government some months ago and which I chair.

It will draw on the Strategic Roadmap to more clearly define the framework for funding priorities.

And that brings me around to where I began.

Australia needs people to develop the infrastructure and facilities and the workforce to use them.

It could be easy to say, we will just draw on the big research and development powerhouses, the emergent China and India, and Europe, for all our good ideas.

I think I have already made the argument to dismiss what is a simplistic approach to the future of a fair and sustainable Australia.

We need to grow our own scientists and technologists to make things work for us.

As facilities managers with an enormous collective investment in world leading infrastructure you need to be truly multi-disciplinary.

I started to think about what the qualities and skills a good facilities director might need.

They'd start somewhere in the realm of having a good technological base, no doubt, otherwise you might be led up one too many garden paths.

Doubtless, a head for huge numbers would also help, a large measure of patience, a good strategic capacity.

There would need to be the ability to dream but to do it with your eyes open and feet on the ground.

And just to come back to one of my concerns, about research effort largely being driven by what undergraduates consider to be “hot” at the moment, maybe you also need to have a head for history.

I no longer wear them, but flared jeans – or bellbottoms - made an appearance in the 1940s, the 1960s, the 1970s and again in the early 1980s.

So hold this thought if you’re brave, it’s probably just about time for a flared jeans revival.

So trends come and go and come back again. Let's not be in too much of a hurry to sell the farm just because agriculture is out of fashion right now; we will regret it in 10 years time.