Queensland Nanotechnology Alliance

Enabling Tomorrow › Driving the economic development of Queensland ‹

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Science and Innovation Study
Productivity Commission
PO Box 80
BELCONNEN ACT 2600

Dear Sir/Madam

The Queensland Nanotechnology Alliance Ltd (QNA) has much pleasure in submitting our views to the Productivity Commission's research study on the public support for science and innovation in Australia.

The nanotechnology sector is projected to be valued at between $US1 and 2.6 trillion by 2015, with international demand for two million direct workers and seven million indirect workers. Aggregating these figures into Australian data would see the sector valued at $10 - 60 billion by 2015, employing an estimated 125,000 people. The economic value proposition offered by nanotechnology will only be attained if the right policy landscape is developed. It is for this reason that QNA presents this submission.

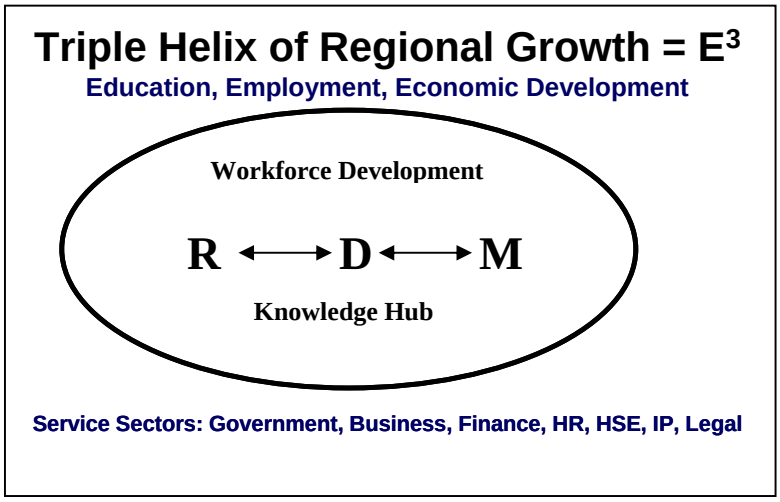
Who is the Queensland Nanotechnology Alliance

The Queensland Nanotechnology Alliance Ltd (QNA) is Australia's first business alliance founded to advise the Government on the dramatic impact nanoscience and technology will have on current and future products and turn of the century industrial processes. This industry led, research supported, nanotechnology alliance, comprises companies that underpin Queensland's current and future economic growth (eg mining, agriculture, construction, biotechnology, marine, aviation, microelectronics).

Until recently, nanotechnology stakeholders operated in isolation. Over the last 18 months the industry has addressed this shortcoming by forming the QNA and NanoVation Australia Pty Ltd (NVA) – NVA being the commercial arm of the QNA. The formation of QNA occurred through the voluntary efforts of dozens of

industry leaders and reflects the broad industry support for the economic benefits nanotechnology can bring Australia.

Membership of the QNA includes established companies such as Boeing, Alcan, Orica, G James Glass; and emerging technology companies such as Microwave Materials and Design, Miyotech, Bio-Layer, Very Small Particle Company and representatives from each University in South East Queensland. The alliance also has a range of associate members, such as the Australian Institute for Commercialisation, Australian Microelectronics Centre, UniQuest, The Centre for Business and Industry, the Queensland Government and professional service firms. Additionally, the QNA also has strong links with international nanotechnology bodies, including the American NanoBusiness Alliance. Appendix one provides a diagram of the 27 foundation companies of the QNA.



QNA is a hybrid model that comprises and encourages collaboration between the three key stakeholder groups in the nanotechnology market place. The three groups are: Researchers (R), Developers (D) and Manufacturing (M).

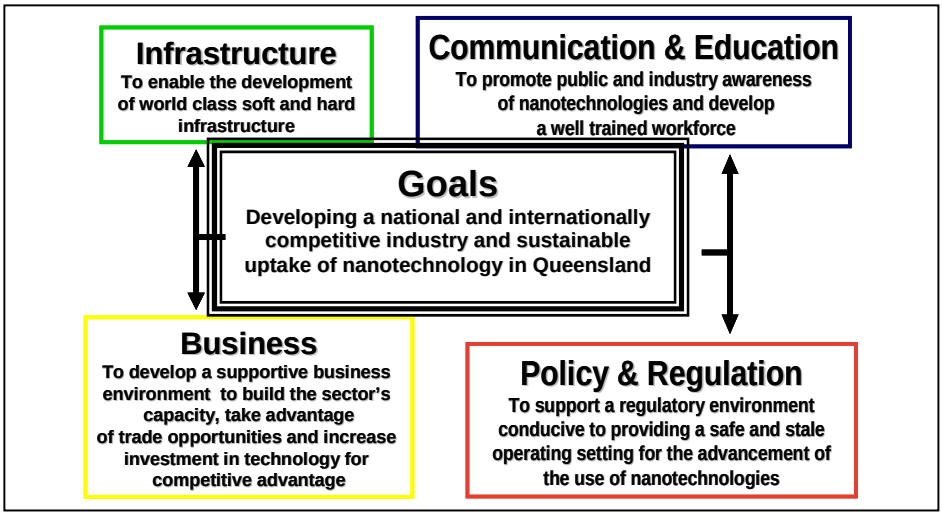
QNA supports the Triple Helix of Regional Growth = E^3. This being, through education and employment, Australia will benefit through economic development. The QNA model is portrayed in the table above.

Given the QNA's core principal including E^3, we believe we have much to contribute to the productivity commission's research study into the economic, social and environmental returns on public support for science and innovation in Australia. The QNA encourages members of the Productivity Commission to meet with a representational group of QNA members to further understand the key value propositions that we believe would develop a

- ***Researchers*** **– universities and research organisations who develop new knowledge in all aspects of nanotechnology.**
- ***Developers*** **– research organisations and start-up companies that are (a) transferring new knowledge into prototypes and products that are enhanced by nanotechnologies (eg fuel cells, composites, sensors) and/or (b) developing new nanoscale components that can be incorporated into a new material**
- ***Manufacturers*** **– incorporate proven nanotechnologies into current processes and products thereby generating innovative products offerings for the market.**

science and innovation sector in Australia that would achieve the E³ principals.

The QNA is committed to working with the Federal Government and other government and decision making agencies, to ensure science and innovation policy formulation that provides economic growth mechanisms that boost Australia's economy rather than create an environment in which our research is developed and commercialised internationally.



To help the QNA understand the nanotechnology community's policy requirements, four sub-committees have been established to examine the areas of infrastructure, education/skills, business and policy and regulation. The above table explains the role and goal QNA achieves through these groupings.

Why a strategic investment in nanotechnology and related technologies will advance Australia

"*While knowledge development and nanoscience R&D create value, it is through the commercialisation of nanotechnology into new processes and products that businesses will create jobs and nations will see a return on their investments*."
Sean Murdock, US NanoBusiness Alliance

The above quote from Sean Murdock, executive director of the US NanoBusienss Alliance, emphasises how a strategic investment in nanoscience and related technologies will allow Australia to enhance the building of a sustainable, knowledge based economy. This initiative must have the long term objective of generating commercially viable, long term manufacturing opportunities. Only then will the manufacturing sector invest in further research and new product development infrastructure to maintain and extend our global competitive position, enabling education, employment and economic growth.

Australia must act decisively in identifying regional strengths (competitive advantages), building development infrastructure and exploiting these in a local and global sense to:

- Accelerate high value added manufacturing
- Leverage high value Research and Development
- Stimulate high value employment

Thus enhancing life in our region, and for our children.

Unless the model of engagement between the stakeholders is modulated to reflect the current economic and technical life-cycle of our region, investment in basic research without adequate capital support for the start-up companies it produces will not result in economic development. It will instead create intellectual property opportunities which will be commercialised by competitor nations.

What is nanotechnology

Nanoscience involves studying and working with matter on an ultra-small scale (one nanometre is one-millionth of a millimetre). Nanotechnology is the application of nanoscientific developments toward commercial outcomes. Nanotechnology will lead to dramatic and disruptive changes in the way materials, devices and systems are understood and created.

By disruptive technology, it is a new technology that unexpectedly displaces an established technology. Many of the members of the QNA are not working directly in nanotechnology, however, these companies are aware that as a new technology matures, the status quo can be threatened.

Producers of nanotechnologies include research institutions and small to medium enterprises (SME's) involved in a range of activities across the established disciplines of physics, chemistry, biology, materials science and engineering.

Consumers of nanotechnology comprise numerous industries including microelectronics, minerals processing, materials science, biotechnology and business services.

Nanotechnology business objectives have been incorporated into multiple Commonwealth Government Action Agendas (including Mining Technology Services, Science Industry, and the Electronics Industry) and the Global Intelligent Manufacturing Systems (IMS) program, an industry-led R&D initiative established to develop the next generation of manufacturing and processing technologies.

Nanotechnology was recently assigned a US Patent Classification number (977).

International economies fund nanotechnology as it has the potential to profoundly change our economy and to improve our standard of living, in a manner not unlike the impact made by advances over the past two decades by information technology. While commercial products are starting to come to market, some of the major applications for nanotechnology are five to ten years out. Private

investors look for shorter-term returns on investment, more in the range of one to three years. Consequently, government support for basic research and development in its early stages is required in order to realise nanotechnology's full potential and to maintain a competitive position in the worldwide nanotechnology marketplace.

Worldwide we currently enjoy numerous products featuring the unique properties of nanoscale materials. Most computer hard drives, for instance, contain magnetoresistance heads that, through nano-thin layers of magnetic materials, allow for a significant increase in storage capacity. Other electronic applications include non-volatile magnetic memory, automotive sensors, landmine detectors and solid-state compasses. Some other current uses that are already in the marketplace include:

- Burn and wound dressings
- Water filtration
- Catalysis
- A dental-bonding agent
- Step assists on vans.
- Coatings for easier cleaning glass
- Bumpers and catalytic converters on cars
- Protective and glare-reducing coatings for eyeglasses and cars
- Sunscreens and cosmetics.
- Longer-lasting tennis balls.
- Light-weight, stronger tennis racquets.
- Stain-free clothing and mattresses.
- Ink

Researches are currently working on solar cells in roofing tiles and siding that provide electricity for homes and facilities. The vision of researchers working in this field is a much cleaner environment due to greater use of solar energy (and less burning of fossil fuels) and a higher standard of living for the many parts of the world that do not have access to efficient, reliable energy.

The pharmaceutical and chemical industries are being impacted greatly by nanotechnology, as well. New commercial applications of nanotechnology that are expected in two to five years in these industries include:

- advanced drug delivery systems, including implantable devices that automatically administer drugs and sensor drug levels and

- medical diagnostic tools, such as cancer tagging mechanisms.

Future uses for nanotechnology are harder to predict, but today's predictions center on pervasive computing applications. It is believed that nanotechnology will facilitate the production of ever-smaller computers that store vastly greater amounts of information and process data much more quickly than those available

today. Computing elements are expected to be so inexpensive that they can be in fabrics (for smoke detection, for instance) and other materials.

Nanotechnology in the Australian Policy Environment

The Prime Minister's Science and Engineering Council (PMSEC) Working Group[1] found that:

- Australian nanoscience capability is strong but fragmented;
- There is poor awareness of nanotechnology in mainstream industries, even though nano-enhanced products are on the market (the nano component therein is often invisible to the consumer);
- There is the potential for the creation of a new industry that develops and manufactures nanotechnology inputs for other industries, but this is hampered by a lack of prototyping infrastructure;
- Where there are unknown health risks associated with some types of nanopowders, the occupational health and safety (OH&S) and chemical safety regulations will need to be examined to ensure they remain effective;
- Other factors such as skills, inwards investment and basic measurement science (nanometrology) are lacking and need to be addressed;
- The general public is not aware of what nanotechnology is, but nonetheless, the community sees it offering both positives and negatives.

The PMSEC findings predicate the innovators dilemma. The vast majority of innovations contribute to the sustainability of a business and most companies capable of managing growth in such an environment. In the case of disruptive innovation, such as nanotechnology, there is a strong first mover advantage and likely to be an above average return on investments on appropriate research and development (Christensen 1997)[2]. Disruptive technologies bring to a market a very different value proposition compared to incremental innovations; however the market opportunity has to be mapped in order to analyse and determine an appropriate entry strategy.

The Department of Industry, Tourism and Resources is expected to release a nanotechnology strategy in September 2006. Any delays in the release of this document will indicate that the projected economic impact of this sector is not appreciated within the department and hence not of critical importance in Australia.

Economic benefits of nanotechnology

The nanotechnology sector is projected to be valued at between $US1 and 2.6 trillion by 2015, with international demand for two million direct workers and seven million indirect workers. Aggregating these figures into Australian data

[1] http://www.industry.gov.au/content/itrinternet/cmscontent.cfm?objectID=E2FE4F8A-4E44-4785-A6A01BE137E0E524
[2] Christense, Clayton, 1997 "The innovators Dilemma: When New Technologies Causes Greater Firms to Fall"

would see the sector valued at $10 - 60 billion by 2015, employing an estimated 125,000 people (Roco[3] and Lux Research[4] and Australian Financial Review[5]).

The above estimated value of nanotechnology both internationally and for Australia is significant. Yet investment in the nano sector is small and disparities exist. As noted previously in this document, the research sector is the major benefactor of government funding, with very little government or private support available for the development or manufacturing sectors.

By the beneficial implementation of nanotechnology, QNA members and aligned industries will generate products and solutions that were not possible yesterday. The products will be more durable, resulting in lower turnover and more productivity, be manufactured at smarter and energy efficient production facilities, and thereby supporting the development of a knowledge based workforce, that is nimble and responsive to global variances. By implementing supply chain efficiencies, in terms of human and energy inputs, we will be able to support a globally sustainable, industrial society.

The drivers that the nanotechnology market requires to accelerate economic development include:

1. Increase the size of the funding pool for nanotechnology overall
2. Appropriate distribution / support for funding between the three stakeholder groups that make up nanotechnology
3. Infrastructure resources for the establishment of prototyping equipment
4. Establishment of a nanotechnology incubator
5. Commitment to encouraging education in science, commencing with strategies aimed at primary school students
6. Programs to encourage exploitation of scientific discovery in Australia and the encouragement of attaining global licenses to develop niche high value industries in Australia
7. Greater movement towards costing IP in a similar way to the US compared to existing Australian models
8. Social networking support

1. Increase the size of the funding pool for nanotechnology overall

In the United States, Federal funding for nanotechnology R&D has increased substantially since inception of the National Nanotechnology Initiative (NNI), from

[3] Roco, Mihail "US National Nanotechnology Initiative": Planning for the Next Five Years.
[4] Nanotechnology Business Alliance, US based on Lux Research (NY) data
[5] Australian Financial Review "Nano Work Chases Mega Numbers", June 5, 2006

$464 million in 2001 to an estimated $1,081 million in 2005. In 2006 Federal US funding will remain around the 2005 level.

Highlighting the international importance of funding nanotechnology, The Economist magazine in January 2005 stated “For America, nanotechnology is the largest federally funded science initiative since the country decided to put a man on the moon. In 2004, the American government spent $1.6 billion on it, well over twice as much as it did on the Human Genome Project at its peak.”

The US is not the only country to recognise the tremendous economic potential of nanotechnology. While difficult to measure accurately, some have estimated that worldwide government funding has increased to about five times what it was in 1997, exceeding $2 billion in 2002. Asian countries, including Japan, China and Korea, as well as several European countries, have made leadership in nanotechnology national priorities.

QNA is not in a position to quantify the value the Australian government has committed to nanotechnology, whatever the figure is; even a doubling of the value would still see Australian public spending far below international levels. Even Biotechnology in Australia, which is around 1/3 to 1/2 the size of the nanotechnology growth value, is funded to a higher level in Australia.

2. Greater equalisation of the distribution of funding between the three stakeholder groups that make up nanotechnology

The QNA we strongly believe that the current funding for science in Australia is not in equilibrium, and therefore is not aimed at optimising domestic productivity.

In fact, QNA would argue that allowing the current relationship the Australia government (and State governments) advocates in terms of funding research to the detriment of funding development is one of the core problems that is inhibiting economic growth from science and therefore inhibiting innovation.

Unless there is greater (pro rata or some scale factor based on the 1, 10, 1000 rule, that is $1 for research needs $10 for development and will result in $100 marketing) government commitment and capital support for start-up companies (many of which are spin-offs from university research), Australia will not be in a position to take advantage and therefore foster economic growth though innovation.

The current situation promotes what is called the “valley of death” syndrome. The valley of death is the place between proof of concept and implementation – between company formation and its producing cash flow. The valley is especially acute for firms involved in nanotechnology, as early stage technology firms need adequate capital to segue from basic research to commercialisation but funding

from venture capital sources has been insufficient to promote economic development.

It must be understood, that QNA is not auguring for current funds to be distributed between the three sectors, QNA is arguing that the funding pool needs to increase with developers and manufacturers gaining.

3. Infrastructure resources for the establishment of prototyping equipment

To help solve this problem, QNA recommends federal investment in nanotech user facilities. These facilities, would provide access to modern, state of the art equipment and the human capital to drive the instrumentation and contribute to the development program. Such hard and soft infrastructure is not readily available for industry due to the capital intensity of nanotech commercialisation activity and the lack of skilled technicians with the practical, worldy experience. The government must also ensure sufficient operating funds to provide services and train the start-ups, or the assets will be underutilised and the investment will not generate the return expected.

QNA recommends that the federal government should use its grant programs more fully and effectively to enhance commercialisation. A program that would benefit nano start-ups would be the more rapid incorporation of nanotech into government programs and purchases would be of greatest aid to companies.

Rapid integration would generate a sustainable source of revenues, provide customer validation and feedback, and enable nanotech companies to gain critical scale-up manufacturing experience to ensure we can produce critical technologies domestically. Furthermore, doing so will ensure that our agencies, including for example, Defence, remain ahead or at least on par to the world in terms of nanotech integration capabilities.

4. Establishment of a nanotechnology incubator

QNA supports the establishment of a nanotechnology incubator that provides space and resources to help high tech companies grow and expand, while advancing Australia's programs in science, technology and business.

The incubator also provides a broad range of services including assisting emerging companies, their staff and incubator staff and students to create successful technology companies. Successful incubators have imparted important lessons that is not just breakthrough science or technology that makes a company successful. It is also strong business strategies, marketing, sales and financial management.

5. Commitment to encouraging education in science, commencing with strategies aimed at primary school students

QNA is committed to the teaching of science from primary school through to university level. We need more 'real science' in our school science lessons. Science learning needs to inspire our future scientists and citizens by being challenging and creative. Real science Encouraging experimentation and investigation in school

Added to the problem of surmounting the valley of death is the shortage of skilled Australian workers in science and technology. Australia is slipping far behind our competitors -- Asia in particular -- in undergraduate and graduate training. Australia needs a well educated talent pool to survive.

6 Programs to encourage scientists to (a) stay in Australia and (b) encourage overseas scientists to move to Australia

The Department of Education, Science and Training is currently undertaking work in skill shortage areas in emerging technologies, focusing its activities on the Photonics and Nanotechnology areas. The Working Group Report highlights a number of issues, including:

- the difficulty of defining the skills needs associated with using Emerging Technologies;
- the need to provide appropriate and timely training for existing workers; and
- the need to provide training which combines business, commercial and technical skills.

The findings noted above represent, in QNA's view, problems associated with technical staff and does not address the professional staffing issues. There are simply not enough Australia students (or international students who study in Australia) undertaking doctorates. Added to this, regional areas of Australia are not able to retain skilled resources with the traditional issues of brain drain.

Asian students undertaking PhD's were at one stage filling gaps in countries like the US and Australia, however, these students are now staying within their own countries as their government build their nanotechnology sectors and provide them with the challenging jobs they require.

7. Greater movement towards costing IP in a similar way to the US compared to existing Australian models

Commercial entities understand that to obtain IP from a University, some type of fee will need to be incurred. The issue is the absolute value of the fee and when it is to be incurred. Policies allowing public supported IP to be transfer to local companies would stimulate growth by creating high value opportunities locally. These opportunities would result in jobs and manufacturing / products / services locally, but with a global reach. IP policy today is directed more at the absolute quantum of monetary return for the public institute, not the triple contribution the IP could impart on the local community.

8. Social Networking Support

There are two definitions of social networking supported by QNA. (A) MIT, Stanford, UCSD and many other campus globally support the development of long term alumni relationships. These social networks were an essential aspect of the success of Silicon Valley and Research triangle park. Further, cities such a San Diego are predicated on the use of social networks to exploit hard and soft resources.

(B) QNA has been able to develop a database of over 2000 people involved in nanotechnology in Australia. By undertaking knowledge sharing events we are able to encourage collaboration and information sharing resulting in new partnerships. However the activities of the QNA have been hampered by no funding being available to the QNA to assist us develop the networks.

9. Regulatory Environment

On the pathway to this energy and resource efficiency, we are aware of two broad categories of risk assessment that will need to evaluate:

a) Biological systems: how nanoparticles affect bacteria or how they accumulate in individual cells.
b) Environment. Do nanomaterials accumulate in water or the earth, and if so, do they pose a risk?

As an industry alliance, the QNA must remain at arms lengths from basic studies as interaction is likely to draw concerns over commercial interests in the outcomes. However, the Alliance would support the dissemination of information and public discussion. It's by understanding nanoparticle properties, QNA members and affiliates can engineer around potential problems resulting in a triple bottom line outcome for society, the environment and hence a sustainable economic future.

The Queensland Nanotechnology Alliance Ltd stresses to the Commission that we would welcome the opportunity to meet with you on a face to face basis and to expand on some of the positions we have raised in our submission.

Yours sincerely

Carla Gerbo
Director (Secretary)

Appendix One:

Foundation Members
Queensland Nanotechnology Alliance Ltd

Queensland Nanotechnology Alliance

Enabling Tomorrow › Driving the economic development of Queensland ‹

Foundation Members - Queensland Nanotechnology Alliance:

Brisbane Surface Analysis Facility
Innovation centre
ACME nano products
MiyoTech Limited
G.James is glass
University of the Sunshine Coast Queensland, Australia
Bio-Layer
ARC Centre for Functional Nanomaterials
The University Of Queensland AUSTRALIA
ALCAN
Future Materials
RIVIERA
BOEING
microwaveandmaterialsdesigns
QUT
ORICA
USQ AUSTRALIA
NANOMICS BioSystems
Griffith UNIVERSITY
very small particle company pty ltd
AIC Australian Institute for Commercialisation ideas → opportunities → outcomes
QUEENSLAND COTTON
The Centre