Innovation, R&D and Creating A Competitive Advantage

Dr. John Blakemore, BSc, MSc, PhD,
FAICD, FIEAust, FAIM, FQSA,
Nuclear Engineer, Scientist, Management Consultant,
Blakemore Consulting International,
Sydney,

john@blakemore.com.au
www.blakemore.com.au
+61 2 414 970 758
0414 970 758

1. Innovation and R&D, Keys to Prosperity

1. Background.

Australia often struggles to trade in surplus because most of its trade is in commodities like coal and iron ore. Commodity trade involves large volumes of raw materials of low value goods when compared with moderately transformed or highly transformed manufactured goods. The main drivers of economic growth are productivity due mainly to improvements resulting from the application of technology and skill and the new creation of intellectual property and its application, particularly by adding value to lower value products.

The new free trade agreement signed with South Korea will accelerate the demise of the Australian automotive industry but could enhance the component manufacture for aerospace and transport if the full strategic advantage of Australia's Aluminium supply chain is fully exploited. A free trade agreement with Japan will end the involvement of GM and Ford in Australia and maybe Toyota as well.

It is in the long term national interest to trade in surplus not deficit otherwise there is a never-ending loss of control of national assets. Economists argue that trading in deficit does not matter as long as overseas companies are willing to invest in Australia, but what this view fails to recognize is that the control moves overseas and therefore most often decisions made are not necessarily in the Australian national interest. For a nation well endowed in resources like Australia, there is a strong temptation to use this wealth to live well and rely on imported international goods. Unfortunately this attitude historically, has led to a burgeoning international private personal and private corporate debt. This is balanced by a massive inflow of capital much of which is used to buy assets or invest in developing intellectual property owned by the overseas entity. Some capital is used to re-equip existing plants but these are often overseas owned. Entity purchase here is not balanced by Australian investment in overseas entities because the Australian funds are not available.

Japan is tackling its current problems with an increase expenditure on R&D. At 3.67% of the GDP it is now the highest in the world. Australia languishes at 1.2% despite the fact that we are supposed to have the strongest economy in the world. Private companies like Honda spend in excess of 5% of their revenue on R&D.

There is only one practical solution in the short term. This involves the painful reconstruction of a viable value adding manufacturing industry. The service industry provides 70% to our GDP but has not greatly helped our exports.

We must create a value adding society, focused on innovation and education using our natural comparative advantages. Some of this can be in the service

industry like education, design, research, medicine, for example, but the opportunity is greater in manufacturing because some significant comparative advantages are there already.

It is essential in an advanced developed nation that equal opportunities are given to all talented people regardless of their profession or special skills provided that these are in the national interest for the betterment of society. Increasing our manufacturing capability is one significant way of achieving this and broadening intellectual opportunity at the same time as improving our standard of living and balancing our trade.

Recent studies of productivity growth in Australia have revealed that the most significant contributor to productivity growth is warehousing. Warehousing does not add value to a community other than enable them to consume imported manufactured goods and perhaps employ a small number of people in the supply chain. This does not contribute to value adding for society even though it increases our GDP. One can argue therefore that the raw economic measure of productivity growth based on GDP is in error. After all, Italy once increased its GDP by 20% by suddenly estimating the size of the black-market and then claimed at that time that they were more productive than Britain.

We urgently need to develop an intellectual culture that values highly, skills in science and engineering that add to the wealth of society.

An innovation policy must aim to create wealth from industries and activities where, at least in the first instance, we have a comparative advantage. Later we can create such strategic advantages. Such an advantage must account for our natural resources in materials and people and position in the world aimed at competitive equilibrium but mindful of all moral sentiments.

This means we must develop an innovative system which enables small Australian owned businesses to tap in to the world's intellectual knowledge quickly and seamlessly and use the technological scientific and engineering resources available which are continuously upgraded with superior education facilities at school, colleges and universities. It is useless however to train more scientists and engineers if they have no job to go to. Barriers to business created by state bureaucracies must be removed.

Professional bodies can also play a significant role in the wider community. Scientists and engineers should no longer be invisible. A totally free market or completely unhindered free use of capital is not the answer as the current financial crisis has illustrated. A model similar to that in Denmark with a superior balance between the welfare state and Adam Smith's invisible hand and flexible security systems can improve Australian society significantly, but first we need to trade in surplus.

The government and Keynesian economics are the way forward. Incentives are needed in a truly cooperative system with an elevation of the need to create a new society focused on long-term growth using science and engineering education and its application to innovative processes and products as a driver.

The current innovation system is not yielding the best result for the Nation. Much of this has already been enunciated in recent Productivity Commission reports and numerous parliamentary studies. It is not intended to repeat their findings here but the following facts are highly relevant to a current review of our National Innovation System.

1. China also has a very great need for capital but trades in surplus and has a high savings rate currently used to invest in its own innovations and buy assets abroad. Australia's savings rate is one of the lowest in the developed world but is improving.

2. Our research and development expenditure as a percentage of GDP is low for as developed country and is mainly in the public sector by institutions such as the CSIRO. In the aggregate, private companies contribute little because of the poor R&D effort of many corporate overseas giants. Some small SME's contribute up to 20% of their turnover to R&D to remain ahead.

3. The CSIRO's contribution, whilst significant, unfortunately is too thinly spread in too many areas and in fact 50% of its expenditure on R&D in manufacturing is in areas where Australia does not have a comparative advantage and is therefore not used as effectively as it could. It is recognized that too sharp a focus can stifle creativity and inhibit the development of new products, however, we need a better balance.

4. The current government funded R&D schemes and those in the past have been overly bureaucratic and the failure rate is high. Recent changes have been very beneficial. Too often the assessment process involves only paper filing and no audit. **R&D auditors are needed to improve the success rate**. Successful projects are rarely commercialized in Australia because of the reluctance of Australian venture capitalists to take a reasonable risk on innovative products and processes. VCs are focused on money so we need some sweeteners from government, tax concessions or matching grants.

5. Overseas ownership and control often results in ideas developed here being exploited overseas instead of Australia. This has occurred with three major Blakemore Consulting Innovations. Worse still, multi-nationals with operations in Australia tend to do their R&D closer to their head office.

6. Scientists and engineers are largely invisible in Australian society except on global warming, and comments made by those who wish to make public statements, are not supported by those who control the media. Hence a lot of

incorrect scientific information is spread about. Many journalists and economists are guilty of this. Such misinformation is probably due to the very poor understanding of science by the general population. Engineers and scientists have a good understanding of many technological problems, however because they realize they are not experts, they are reluctant to make public comments. This vacates the stage for people with little or no understanding of the problem who are usually driven by ideology. Scientists and engineers need to stand up and be heard and need a strong advocate in government. **The current Chief Scientist fails badly here.**

7. The CSIRO and Universities staff and equipment are not readily available to the general business community who therefore are unaware of the true capability of this resource and the untapped knowledge. R&D innovations need to be digested and promulgated to the business and general community.

8. Professional institutions like the Australian Institute of Company Directors and The Australian Institute of Management are not scientifically focused. Additionally, many companies do not have a scientist or engineer on the board and they have no policy on innovation.

9. Venture capitalists are reluctant to invest in technological research or they place unrealistic timetables to deliver outcomes. This is related to their lack of scientific understanding, risk aversion, and their short-term focus and the fact that they do not understand the nature of the spin-offs that will occur. VCs are not risk averse in general but tend to take risks in the financial world since they believe they understand this a little better.

2. The Current Innovation System.

The poor performance of our existing innovation system therefore has the following elements:

- A non-integrated approach of the necessary parts needed to achieve success.

- Lack of cohesion and priority setting between the universities, private and public R&D centres, CRC's, and particularly SME's. Each commercialization project needs an effective leader who can bring together all the resources necessary to improve the probability of success. Perhaps the government should support SME entrepreneurs up front after

rigorous project evaluation, and insist on payback only after success is achieved.

- Trying to be expert in two many industry sectors without a recognition that we have a significant comparative advantage in some areas but not others.

- A mining sector that has adopted a short-term vision of maximizing short-term profit by sacrificing downstream value adding activities. (e.g. the separation of BHP Billiton from OneSteel and Bluescope Steel). Maybe we need to tax them more heavily unless they contribute in a more cooperative way to downstream processing.

- The lack of simple mechanisms to raise capital by SME's in particular.

- The lack of mechanisms to retrieve knowledge from patents, universities and research establishments. With regard to patents, the information is available to some extent from IP Australia and overseas web sites, but it is not easy to access. A journal digesting and summarizing latest published applications and granted patents may make patent information more available to both business and technologists so the left hand knows what the right hand is doing.

- The lack of a suitable Australian journal for publication with a large number of fragmented journals all doing a piecemeal job. "New Engineer" attempts to do this but is under-funded and the circulation is poor.

3. Conclusion and Improvement Concepts

An innovation system policy should be needs driven and therefore focus on the following. It is recognized that tax and other incentives will be needed to implement many of these concepts.

- A long-term innovation plan for the next 25 years, updated every year as circumstances change, sharply focused on rebuilding an economy trading in surplus not deficit.

- Special support for the food industry and the health industry and companies willing to work supportively with the medical devices supply and manufacturing system.

- Using skilled R&D auditors and assessors to improve the probability of success of R&D grants. **Filling in a form is not good enough. Such auditors will need to be well educated at PhD level and well rained in quality auditing and project assessment in all functions, marketing, sales, operations, quality, finance, engineering and science**.

- Rewarding companies that are innovating in those areas of national interest where Australia has a strategic advantage.

- Insisting that at least until our Balance of Payments problems are solved, programs of R&D are sharply focused on the national interest on value added activities where we have a natural comparative advantage, capitalize on our resources like minerals, sunshine, wind-power in the south, natural gas, bauxite to lightweight transport and aerospace components, high value technology and medical and scientific instrumentation for example.

- Focusing sharply on solar energy, photo-voltaics and wind power and cleaning up coal fired stations. We have already shown we can be world leaders in photo-voltaics (Suntec China), but the opportunity to commercialize was not supported.

- Supporting the focus of Government's efforts to build cooperative networks in research institutions, universities, the CSIRO, TAFE colleges and industry.

- Encouraging Government to establish systems to enable a less costly access to professional staff at these institutions for industry and expanding the researchers in business system particularly in training managers to innovate and drive process and product development. They clearly do not understand the need to continuously reduce cycle time.

- Enabling quick and shared access to equipment, facilities and knowledge at universities and the CSIRO in the first instance.

- Supporting industry leaders in science and engineering to offer services and experience to schools and educational institutions.

- Rewarding process innovation equally as product development and applied and basic research.

- **Encouraging industry to license intellectual property until they catch up.**

- Encouraging venture capitalists to invest in the commercialization of Australian intellectual property rather than risky opaque methods of financial shuffling.

- Setting up cooperative research centres run by business people not academics (similar to Panasonic).

- Re-instituting a more attractive tax regime for research effort in the private sector with special emphasis on commercialization particularly for Australian owned enterprises but offering less support for overseas owned entities unless they provide a plan to build our economy not simply ship profits back to the parent.

- Establishing a patent information referral centre like the original Australian Patent Information Service (APIS) and marketing its value to industry.

- Offering a graduated scale of R&D grants which are more attractive for targeted industries in the national interest where we have a defined comparative advantage but less in areas where such an advantage has not been established.

- The development of database of all Australian expertise.

- Educating CEO's and board members so that innovation is firmly established on the board's agenda.

- Educating CEO's on how process innovation can pay for itself quickly and soon add significant value to the triple bottom line using demonstration projects.

- CRC's run with a business CEO or professional business oriented engineer or scientist, not an academic in charge, modeled like Panasonic, Sony, TDK, JVC., and the models in Ireland in particular using rapid development process and product innovation systems like Honda.

- Direct encouragement for manufacturers to continuously increase the value added component of their business following the principles ably practiced by Honda, Toyota, Panasonic, Canon, and encourage the use of point of sale digital data to accelerate process innovation and supply.

- Encouraging cooperative programs of research in Australia particularly with Japan.

- Measuring and rewarding R&D grants by output instead of input. We don't want to duplicate the ARC grant system to universities where excessive

emphasis is given to academic publications and previous research grants. This leads to a "rich get richer" effect which makes it difficult for new players and ideas to get support.

- Increasing the awareness of scientific thinking in schools, universities and colleges and the wider community.
- Teaching the scientific method to all and demonstrating what science and its application can do for the finance industry.

Creating a Competitive Advantage for Australian Manufacturers

Generally, our whole economy is based upon low value added products whilst world trade is predominantly about high value added products. Commodity prices and the terms of trade have been high for the last two years. Australia's high value added infrastructure is very poor. Intimately woven with this is our poor industrial R&D effort. This is due to the high preponderance of small businesses and their focus on the short-term cash flow. This in turn is due to the low level of process control and innovation. It is not logical to push these firms into making new products, since their processes are very poor. They do, however, need to innovate and renew their business and manufacturing processes and then develop new products. They urgently need process innovation. They need to be taught how to innovate and carry out sustainable R&D. As well as this climate change, whether it is anthropological or a natural consequence of the changes in the earths orbit around the sun, the changed angle of tilt or the SOHO effect, does create significant opportunities for innovative Australian manufacturers.

The Manufacturing Society of Australia and Blakemore Consulting International conducted a development program through the Federal Government's Innovation Access program called "The Creative Innovative Company Program". It is already

clear from the very positive results obtained so far that small manufacturers (less than $50M turnover) need special help which is not covered by existing support programs. The last thing they need at this stage is a new product. In addition, it is now recognized that 70% of the nation's new investment comes from its existing industry base. Hence, this is a good reason to expand it.

Manufacturing generally is not well represented at the professional level and small manufacturers appear to have no group representing them at all. During a discussion with the National President of Engineers Australia last September I was told that "manufacturing is not really engineering". This is borne out by the fact that they do not even have a college of manufacturing. General industrial engineering and operational process methods and knowledge are absent from almost all small manufacturers. Attempts to successfully use the continuous flow techniques (Toyota Production System), have often failed because most companies, particularly SME's, cannot adapt the Toyota assembly systems to Australia's multi-product short run environment. American advisers cannot see past low variety long run supply and hence the methods that will be successful in Australia are significantly different from their perceptions. Australian innovations have already been developed and applied successfully.

Conventional manufacturing methods and planning systems in Australian SME's are highly inefficient but this problem can be rectified if the connection between process innovation and product development is made focusing on the creative flow techniques pioneered by Japanese car manufacturers. Process innovation is a precursor to good product development. These techniques can be applied to SME's. The problem is not the immediate introduction of new products it is the creative innovation and development of the existing processes to manufacture all products. This includes the development process itself. At a recent forum in Sydney, Harvard Professors Sam Hayes and Warren McFarlan now recognize, belatedly, that the key to Japanese automotive success is process innovation and internal R&D and a strong link between process and product innovation, not acquisition, something not widely recognized.

One of the most significant development projects in Australian Industrial R&D was the development of Colorbond (Zincalume) by what is now Bluescope Steel. I was the Chief R&D Development Scientist leading much of this project. This achievement was a result of process innovation.

The secrets of the future development of manufacturing depend upon:

- Taking advantage of our natural comparative advantages (Natural Gas, Aluminium, energy, iron and steel. Food products, for example)
- Capitalizing on the opportunities created by climate change
- Increasing competition and exposure to the international market

- Removing restrictions to industrial productivity improvement by improving Industrial Relations (This is probably going to occur).
- Focusing on and utilizing industries (source and downstream) where we have a natural competitive advantage (energy, bauxite, iron ore, power, nuclear, agriculture etc)
- Completing the supply chain so that we add as much value to the raw materials as possible (consistent with demand and isolation)
- Concentrating on export.
- Continuous innovation of processes linked to products innovation.
- Utilization of patent know-how. (e.g. Colorbond).
- Process innovation by isolating the constraint and improving productivity and utilizing the appropriate technology.
- Introducing continuous flow techniques for all products.
- Rapid product and process development (R&D).
- Replacing Labour with capital.
- Concentrating on the Premium end of the market.

Some Examples of Process Innovation Achievements We can all learn from.

!. Pirelli Cables

Pirelli doubled output and reduced waste by 90% over three years and changed a loss making enterprise to the second most profitable Pirelli Cable manufacturer in the world (second to the main plant in Milan) in three years. All this was achieved without introducing new products. The company then floated and bought its main opposition, Metal Manufactures.

2. John Lysaght(Aust) now Bluescope Steel

John Lysaght (Aust) first licensed the Galvalume process from Bethlehem in the USA. The product was renamed Zincalume. Numerous patent investigations and plant trials established that the stripping process was the major constraint. JL(A) developed a new stripping process and eventually increased productivity by up to 50% and became the dominant supplier worldwide…a result of process innovation.

3. Innovation Access Program Tasmania 7 Companies. (All less than $20M turnover…mostly $1M to $10M)

All the participants have common problems. They are under-capitalized, have difficulty raising money, and have a small market share, and very poor processes and higher than desirable manual handling and manufacturing costs.

In all cases the productivity gains so far achieved under this program are already significant but these gains are small compared with the potential improvements that can be made. In one case we can develop a process where one person can do the work of several.

Relationship Between Process Innovation and Product Development

New products must be developed more quickly but it is not sufficient to just develop a new product. The method of development and the processes used to manufacture them must be innovative as well. This is not currently recognized and as a result, many R&D programs are supported by when they should not.

General

Many of the principles are well established in manufacturing plants in a wide range of industries, particularly in Japan for automotive manufacturers, and electronic manufacturers, These principles can be introduced successfully into any manufacturing plant in Australia but unlike the USA environment, we need to modify the methodology to suit the fact that Australian plants most often must make a very large variety of products. This means that the production runs are often short and there is a lot of pressure put on the manufacturer to maintain high levels of finished goods inventory. In the USA often plants can be dedicated to low variety of products on very long production runs.

Good business practice aims for continuous and never-ending innovation and improvement. This means a continuous emphasis on new ideas in all parts of the business both in product and process but process innovation does not come naturally to all.

The methodology promoted has already been tried in a complex multi-product environment (5500 products, 7 plants. 16 machine types, 20 different processes).

Concept

The concept is to:

- Plan to eliminate the bottleneck and seamlessly link with suppliers and customers
- Create continuous flow and so increase value added time %.
- Link process and product development
- Transfer the measurements to the Profit and Loss account and the Balance Sheet using throughput accounting.
- Take the resultant working capital released and re-inject it into technology and new innovations to increase productivity and reduce labour.
- Continue the process by further increasing the value added time %.
- Continuously upgrade skills and learning of the workforce
- Aim for sustainability in all aspects of the business

Starting with the key principles of creative flow of products and services, operations research, the 14 Toyota Management Principles, the 14 Rules of Dr. Deming and the key links between process and product innovation, a series of concepts have been developed and successfully applied. These need to be understood by all manufacturers, specifically those below $100M turnover. The concept introduced at Shaw with some principles applied at Pirelli and following the methods used on the Colorbond project, needs to be diffused quickly through Engineering schools at all levels. There has to be a continuous understanding that the value added percentage in all manufacturers must continuously increase.

The concept is to take these ideas and apply them through demonstration projects supported by Universities and TAFE following the basic scientific method, and transfer these measurements to all functions of the company, and measure them through the P&L and balance sheet.

The innovation Access program in place in Tasmania can be used as a showpiece. This includes the following companies who are all showing significant benefits. These benefits are most noticeable in those with turnovers greater than $5M. In all cases the lack of internal resources, particularly where the company has a turnover less than $5M per year, has hampered development. However the following have made significant development in a relatively short time. In the case of Muir Engineering, this program has significantly helped the company win the Austrade Export award for a company under $20M turnover.

Conclusion

SME's need help. Generally, the smaller the company, the greater the variety of products and the shorter the manufacturing run length. Simply thinking that the Toyota production System will work in the Australian manufacturing environment without significant innovations will lead to failure. However these problems have been solved. The current "Commercial Ready" program encourages these

companies to develop new products but what is needed are new innovative processes. The guidelines for "Commercial Ready" need to be broadened so that maximum benefits can be obtained from the allocated funds or alternatively funds should be diverted from this program so that the maximum national benefit is obtained.

Dr John Blakemore