

NOTES ON AUSTRALIAN INNOVATION ANATOMY

Much discussion of innovation in Australia is like medicine at the time of Vesalius, when anatomy was little known. To discuss government strategy, programs and funding we first need to agree on the anatomy of innovation for Australia:- what are its parts and how do they all work together? A sufficiently complete anatomy should be filled out by practical innovators in all fields, not theorists like Aristotle.

The Commonwealth should develop and publish an Anatomy of Innovation. The academies have important roles in this effort, but so powerfully represent the status quo of the research world that they should not be responsible for the review. A wiser and more educational way would be to publish several variants, and for government to say openly which one it chooses as a basis of policy. Innovation is creative and unbounded by commentaries, but we need a fair deal of agreement about anatomy before we can decide on national policy - strategy, people, cultures, structures, programs, funding, management and review.

This is not a scholarly review but a practical summary from wide experience over 45 years in R&D, corporate and public service innovation, with organisations large and small. It is based on:

- hands-on experience of managing small and large programs in all types of mineral exploration and feasibility studies; satellite and airborne spectral surveys; magnetic and electrical geophysics; metallurgy; X-Ray and electron instruments; electronics and controls; paints and coatings; air conditioners; building methods and materials; engines; drills
- major innovation in government geoscience surveys across Australia and overseas, reform of government pricing for regional information, and dryland salinity initiatives
- working closely with nine universities, CSIRO and Geoscience Australia.
- changing cultures to an innovation mind-set, battling anti-innovation cultures in large corporations and public service
- lecturing and writing widely on how to manage exploration and scientific business
- being chairman of a CRC for eight years
- reviewing a thousand projects by others, and being on committees for far wider programs from coal conversion to deep ocean mining
- major successes in private and government innovation, and seeing good ideas fail totally.

We see at first hand over decades that innovation does not depend so much on money and expertise which are important, as on a great culture and on particular, incisive review and decision-making processes. These are widely ignored as a package in favour of a few aphorisms.

What is innovation

Innovation is creating new enterprises or new ways of doing things. When successful, it results in economic, social or environmental benefits. It is not always successful or good - Hitler and Lenin were innovative. The culture and processes of innovation have benefits in themselves, even failures teach us something, but R&D are of limited value and may involve large losses, until the innovation chain is complete and benefits are delivered.

Innovation consists not only of the sum of defined projects, but the sum of all incremental improvements and "continuous improvement" as a driving culture shared throughout the organisation, not just a slogan. Even highly successful single innovations need further tuning and improvement over the years.

For an individual project the graph of cash flow against time, Fig 1, applies.

The positive area under the curve after C has to be greater than the negative area preceding, for the whole exercise to be worth-while. This common cash flow graph applies also to the effort that has to be applied to social and environmental causes - the abolition of slavery, or the global warming campaign being big examples.

The assessed opportunity or risk does not vary simply along the sequence, as big opportunities or problems can arise at any stage, including after completion, such as a world economic downturn. The highest financial risk is from when the development expenditure is committed until the project starts to provide benefits. While most direct project risks should be accounted for by the end of feasibility study, large market shifts, competition, or government changes have consigned worthwhile massive developments to the dust bin.

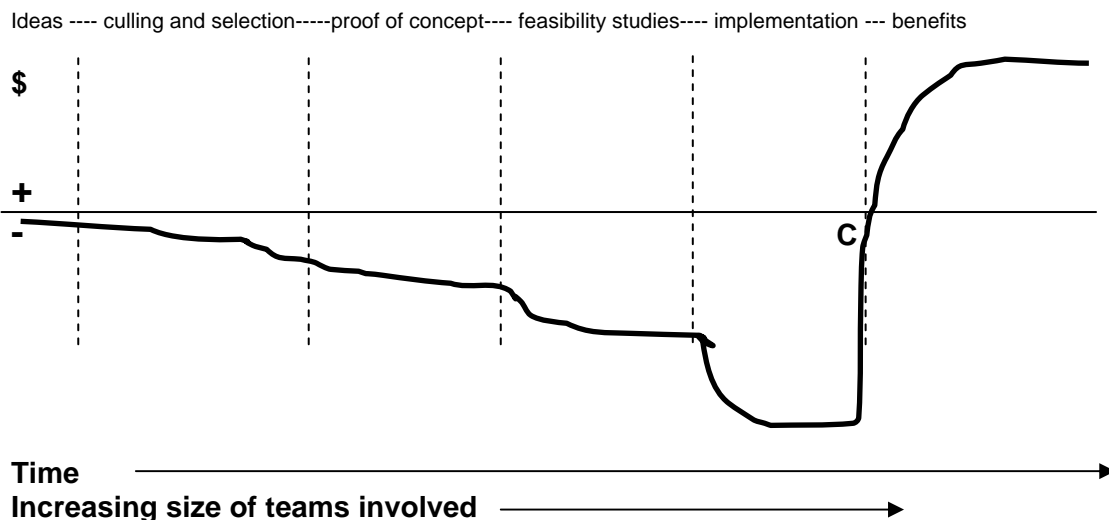


Fig 1. Cash flow against time of an innovation project.

This refers to a single innovation project or movement. It is set within government and private social, political and financial systems and programs of assistance or hindrance.

For a nation, countless failed and successful programs go on simultaneously in all walks of life so that the overall economic and social effort, gains and losses of a country average out and are relatively constant in time compared with the innovation of one company or public service. Policy is to maximise the net gains to the nation relative to investments and losses.

But gains and losses by whom for whom? Unless the gains, in some economic, social or environmental aspect of everyday living, are shared fairly widely amongst the population affected, many people will reject the idea that innovation has been worthwhile. The NAFTA in America is a case in point, the rejection of mining in some regions is another.

Creativity and rigour

Innovation is too often confused with creativity, only half the job. If we summarise innovation as "ideas made to work", we immediately see that it involves the management of creativity melded with the hard-headed, practical testing, assessment and planning for a hard competitive world. It requires melding the elements of creativity and rigour normally associated with very different personality types. The best innovators are personally both creative and rigorous, but if not, then a team is needed and those disparate personalities must be melded into an effective enterprise. Even the "creative arts" take rigour:- a good book, symphony, festival, stage or movie production depends on *making an idea work* for an audience, with meticulous attention to detail and how it all "fits". Most of the arts originated as more like trades, for good reason. Innovation in the engineering or government policy sense is no different. The most obvious area of human activity that does not require rigour is "creative commentary" which consequently is not very useful to government or business.

There has to be mutual respect between the rigour people and creative people, and an understanding day by day of the validity and strangeness, importance and limitations of thinking in only one mode or the other. Too many great inventions fall in the gulf between the ideas person to whom risk is irrelevant, and the engineers or top bureaucrats to whom risk is the fundamental of all their calculations.

Innovation culture and management

Innovation is more than the activities, opportunities and risks, it is an entrepreneurial attitude of mind, a high level of curiosity and willingness to test new ways rigorously but positively, and to adjust our lives to live happily with the new ways. This attitude is a loop, it feeds back to the approach to new ideas. Having this attitude to a somewhat enhanced degree is what distinguishes the west and now some other nations on the same course, from most of the history of the human race.

This innovation culture, while essential, is not an all-or-nothing differential between peoples or organisations. *A positive differential in effectiveness of innovation of 2% per annum, not measurable in society, results in a doubling of whatever in about 35 years.* Therefore even a small increment in positive approach to, and management of, innovation throughout Australia has mighty results in a lifetime, or its absence has mighty consequences in a competitive world. It is irrelevant whether our nation or our organisation can be characterised as "innovative" or not. Can we improve another 2% or 5%?

From the moment an innovation appears on the horizon, most people inside and outside our organisation are ready to oppose it. This is sensible by them because most new ideas fail, and valuable to us as the devil's advocate approach to make sure we are sensible and rigorous enough - so long as our culture and management are resilient enough to overcome the cynicism. Do not throw away gold with the dross. All new ideas look as vulnerable as a fledgling eagle or an oak seedling, but we have no eagles nor oaks unless the organisation has the culture and management systems that can develop these seemingly half-baked ideas into strong innovations.

Innovation requires a unique combination of confidence in all our disparate parts, creativity, generous receptiveness, discipline, rigour and decisiveness. Napoleon at

his best demonstrated such a unique blend, combining audacity with meticulous planning, what we would call scenario planning, and unusual ability to assess a situation and take decisive action. Brunel also combined unique creativity and hard-headed practical, detailed, disciplined engineering. Innovation requires the same combination, through a much longer process than a battle. The great research departments like Cambridge nuclear physics for several decades, the astoundingly successful mineral explorer departments like Roy Woodall's, show that success is only tenuously related to expenditure, and not even totally dependent on expertise, but on the management of creative expertise. Robert Root Bernstein in USA has written on the lack of correlation between bio-research success and expenditure on a national scale.

Money helps, but study of the culture and management of innovation are neglected. Large organisations can be innovative as Jack Welch demonstrated at General Electric, but it took a Jack Welch. His attitudes deserve imitation.

Innovation is the sum of countless *individual ideas*, and then prolonged *team decisions* through the long innovation chain to realisation. The final team may commonly be world-wide, with financial and political and social inputs, checks and balances, from anywhere. The ignored elephant in the room is the entrepreneurial attitude or lack of it in organisations and their management culture and processes. While nations gear up their entrepreneurial support and funding systems, entrepreneurial management is in many areas fading in recent decades, fuelled by fear of failure under public surveillance, and hence "risk management". This has become a craze, a pseudo-management tool and even a farce in many large organisations. A good, necessary plant gone to weed. The very word states the problem: much risk management precludes opportunity management. John Monash came to realise that the audacious "have a go" mentality of a sufficient number of individual Australian soldiers meant the difference in large battles with just as expert and just as brave young Germans more careful about risk management on their side. Monash also handled the risk management better, he won both ways.

The failure of big corporate and public service cultures to manage entrepreneurial opportunity is a negative factor of greater import than systems of national management and finance for R&D. Innovation is our future, yet management of innovation is scarcely taught, and the teaching is often part of the problem, dreadful bureaucratic management burble, not the cure.

There is only faint interest in *studying why some organisations are magnificent innovators while others with more resources and expertise mark time and drain money away*. In big outfits, most rules are laid down by non-innovative controllers, thinking to satisfy financiers. The result is to kill innovation and repel financiers. In the business commentary game, the Peters and Waterman approach is a once-over-lightly by management consultants, not by long-term management participants in innovation.

Incremental Innovation and Continuous Improvement

Much or even most innovation is incremental, as the history of cars, planes, computers, all manufacturing, building and agriculture demonstrate. The hectare produces twice the tonnage of potatoes with less fertiliser and pesticides than the previous generation, and the farmer points to many new things and ways gradually tried and introduced. Now we need a transformation of agriculture again, and incremental advances will be as important as paradigm shifts such as genetic engineering.

Management of the innovative culture of continuous improvement in all we do, can be taught and inculcated to rejuvenate a group. It creates the pinnacle of work experience for those fortunate few who have experienced it to an enhanced degree. Instead we are saddled with people promoted mainly for their dominant personality or for whom they know, rather than for leadership in innovation. Large organisations are populated with managers who have been around long enough to know that any ideas other than their own proven ones cannot work - it is a feature of innovation that it tends to come from small groups where there was no-one to say it could not be done.

Further incremental improvement of already successful new things or ways is very difficult in big bureaucracies. There, any impressive improvement tends to be immediately cemented into policy, and lesser levels in the organisation are told "Don't tinker, you and the customers/users are lucky to have got this far, just get on with it!" But generally, the more successful an innovation, the more it can be further improved.

The key to innovation by way of continuous improvement is a transforming change in fundamental policy: "Our policy is not existing policy but excellence". Existing policy is respected as the best we can do to date, but lasts only until we can do better. The decision whether the new idea is of value is not for any individual but is quickly put to team and management assessment. This policy generates rigour, not ad-hoc mayhem. It is revolutionary if actually believed and committed to. Anyone in the organisation who has a way of improving anything is supported and the idea is tried and tested asap. This was the credo of ServiceMaster in its great decade: "Don't let the sun go down on a new idea". The person with the idea had to sit down with the supervisor or the team *that day* until the idea was canned for good reason or the first step towards testing it was agreed. Bad ideas are quickly analysed and modified or canned without wasting more time, rather than developing foolishly behind closed doors. Sending bad ideas to compost is a very creative feature of good organisations.

It is not any idea per se but the rapid, rational, *rigorous and creative* assessment and testing that matters. The right teams with the right culture and the right decision-making processes can be much more creative in the innovation train than even their most creative individuals. This is a point widely neglected.

Fundamental and applied scientific research

We define fundamental *research* as investigation into the nature of things, without asking whether it is likely to result in useful *inventions*, but believing that understanding the nature of things is not just of value to humanity's view of themselves and the world, but fundamental to all invention sooner or later. It does not matter if the utility payoff comes in ten years, a hundred years or never, it contributes to overall knowledge.

Then there is medium-term research, in areas thought to be of great utility within say 10 -15 years, and then short-term applied R&D, from an inventive concept to proving its usefulness and making it work socially, environmentally or commercially, asap.

Examples are fundamental research into cells, medium term research into how cells replicate, and R&D into possible cancer preventions; or fundamental research into the physics of the planet, applied research into electro-magnetic properties, mathematical modelling and instrumentation, and R&D into a black box that works.

Despite all the criticisms, Australia, through the universities and their R&D institutes, major research institutions like CSIRO, the CRC system, and companies, has got the balance about right. Government funding, across this range of organisations, has seemed about right overall for many decades, and balanced.

The more we practitioners deal with applied R&D, the more we realise Australia must be fully engaged in fundamental and medium-term research, as fertile fields for invention. So must the CSIRO. Universities are the home of fundamental research but must be dedicated, as most are, to transitioning rapidly into medium term research and applied R&D when they find a potential invention.

Capturing the benefits of innovation

In every endeavour, ask, "Who pays, and who benefits?" Can/will an innovation deliver benefits to those who spent the money and time on it, or to the public good? Even "successful" innovation, ie something proved to work, does not automatically gain wide acceptance and reward, hence the attention to commercialisation and marketing. Australians are one of the more inventive peoples on earth, as the Europeans, Americans and Asians know. But does it make us money?

Government R&D boards must ask, not whether they are supporting some company or agency (though that has to be done transparently and fairly) but whether the project will succeed in itself, and then whether the nation can capture the benefits. What is best for the nation? We are not judging the written proposal so much as the reality behind the proposal - is it likely to succeed in benefiting Australia?

Capturing the benefits of economic innovation is a mighty issue for Australia. In mining and agriculture, Australian companies must and do capture benefits of innovation because they are necessary to supply commodities competitively to the world which in most times needs all we can produce. This is why R&D has been relatively effective in these commodity industries. The R&D in mining was largely in exploration technologies, which however had trouble adding value in recent times as discovery has become much more difficult under cover. On the other hand, Australian innovation in mining engineering, metallurgy and management systems has cascaded in the last two decades so that Australia now supplies about 60 % of world mining software, an impressive export development from home-grown innovation. We have valuable technology exports in agriculture, forestry and water.

As against resource exports, the world does not need Australian-made planes, aspirin or phones. Innovation in any major manufactured product that has world-wide application depends largely on access to financial power, ability to sustain costly losses for the sake of a few big wins, and market access and power across the major economies. Australia has done better with niche manufacturing innovation, where such large capital and management resources are not required.

Finland and the Netherlands show what companies from small countries can do when embedded in the edges of super-large markets like Europe and just across the lake from America. Antipodean Australia had huge barriers to world market power, and though our closeness to Asia in space and time zones will become a defining strength for Australia, our European-ness is both a help and a hindrance.

The main reason the financial and business sector does not support R&D so strongly in Australia as in Europe and America is this difficulty of capturing the benefits. The idea is sold to, stolen, shelved or over-run by huge overseas companies.

American, Japanese or European biotech, pharmaceutical, IT, motor or white goods companies are able to dominate the Australian market with their petty change, or China by its low costs. Conversely, it takes more than the cash flow generated by Australian sales of a very successful new product, to break into the Los Angeles market. For decades, the announcement that an Australian company is expanding into Europe, America or China has been a warning flag.

The answer in many cases is to seek joint ventures with powerful world corporations, or to licence, or to sell out. This dismays policy makers. However, in broad terms, Australia can be considered to make an export gain from any innovation where we can capture more of the world benefits of the innovation than our share of the world economy, say 2%. In some cases, we need the clout of huge companies on our side to capture any benefits for ourselves at all, in which case any benefits of doing a deal with them are all gain.

It is difficult to choose the world company to deal with, one that will support the new invention rather than steal or shelve it in favour of a home-grown product. Is the major company a white knight, a dead hand or a vulture? They won't say. Wide intelligence networks are essential, and industrial or cultural misunderstandings increase with the square of the cultural difference.

The huge growth of a couple of Australian mining companies into world powers indicates that Australia has the capacity to produce a few companies like Nokia or Philips or Royal Dutch Shell. But it will be harder than in mining where world-class cash cow mines in Australasia gave initial competitive clout to our big mining companies. Industry must keep governments aware of the different dynamics between resource industries and manufacturing or service industries.

Innovation in social and environmental public good areas, which we all want, has to be watched when it is out of step with other countries. Restriction of metal smelting and refining in advanced countries not only lost business to those countries but exacerbated world pollution by exporting the processing to countries with lower environmental standards and energy efficiencies. Unilateral imposition of carbon taxes by Australians on Australians is likely to have parallel results.

Innovation Dividends

The innovation dividend across all society, the sum of industry and government initiatives, is the astonishing world we inhabit in the developed countries.

Overall, private enterprise and government innovation are equally important. Industry contributes not only economically but environmentally and socially, a point that has to be emphasised. The expertise on regional environments in Australia has derived largely from resource companies, and industry for all its weaknesses is ahead of government in management reform. On its side, governments have initiated massive economic reforms as well as their "public good" programs.

How to measure the dividends? I have been involved in trying to measure them in several major companies for 40 years, and in the public service for 15 years, initially in collaboration with the South Australian Centre for Economic Studies, since then in consulting with five states.

Measuring an innovation dividend is very difficult. We are comparing what happened with what would have happened if it had not happened. It is hypothetical. It is

uncommon for innovation *outputs* to be the sole factor in measurable *outcomes* for any organisation or for society. Other factors intrude: corporate, government or world financial or political settings. Further, if money and effort had not been put into the particular innovation, it would have been spent in some other way, so that we are never comparing an innovative position with a known static one but with a hypothetical.

Someone from econometrics at Murdoch university about 6 years ago made an excellent speech debunking most efforts to measure innovation dividend, to the CRC conference where many people presented glowing estimates of the CRC contribution.

Nevertheless, every group should attempt to measure the innovation dividend of its project or organisation, clarifying their relevant factors and how they relate. The commentary of those who have never wrestled with measurement shows how educational this is.

In companies, the economic dividend for any project can be measured, forgetting for the moment what else might have been done with the money, by the return on investment in the project. As Getty said, if you make money on every investment, you are doing well, no matter what else you might have done.

For overall comparisons between companies, they need to have operated in like circumstances, at the same time. That is the rub. There are no identical companies, so that these are judgemental comparisons, like those between BHPB and Rio Tinto just now, where the differences are slight. Western Mining Corporation, then WMC, over the glory years from 1966 to the 1980's, then the decline until it was ignominiously sold, illustrates the dividends of innovation, and the lack of them, and that innovation or its lack derive from the top. Mt Isa Mines was a very similar case. That is, blatant examples are clear despite the uncertainties.

It takes insiders who understand the contributing factors to their organisation and to similar ones over the same period, to decide what the innovation dividend is.

Customer feedback, if properly and objectively made, is also very important for company assessment. Customers will know if your innovations are serving them well, but not your cost/benefit figures.

Any numerical figure for innovation dividend with more than 1 significant figure is unrealistic.

For government innovation, very complex economic analysis is required, as we see from the plethora of conflicting commentary from all sides. In public affairs there is even wholesale disagreement as to what constitutes public good. The current conundrum is how much of the good of modern world economic development, now centred on China, is balanced by the environmental damage.

Calculations of innovation dividend in the public domain must therefore be very careful to spell out transparently the factors taken into account and those omitted. Then informed people may apply their "correction factors" for their own purposes. This transparency is rare for party political reasons.

Assessment of Performance, Blame and Risk Aversion

This issue is important to the innovation culture of an organisation or of a nation, and needs more public emphasis. People act for their own careers, and the chance of blame, especially false blame, reverberates back through the culture at all levels to increase risk aversion. In the real world, blame and fear of failure are useful influences on decisions, and real innovators are willing to take justified blame, but not unjustified.

Innovation is by definition the most difficult thing we do - trying the new where there are fewer guidelines. Managing large stable enterprises is difficult for most government and much of industry now, so that innovation should be given more rope. As in assessing the dividend, it takes insiders to the innovation chain to assign credit to individuals or teams. A decision seen in hindsight might be obviously bad, but clear hindsight is the privilege of the reviewer. If a major innovation fails for causes beyond the team involved, then blame is not to be levied. If the failure was due to a reasonable try but did not succeed, that might be commendable. Failed but well-designed experiments are as valuable in industry and public affairs as in science, if handled rightly. Only those prepared to fail can innovate. But it is human nature to blame those in the direct team for any failure.

In societies that cannot manage well, most innovation fails, so any sensible manager avoids innovation, for obvious reasons of personal advancement or survival. Prestige flows from position in the hierarchy, not from trying to achieve anything. And the same applies strongly in our own culture, it reverberates through all bureaucracies, hence their risk aversion.

The other main reason for risk aversion in large organisations is simply the scale of impact. Get it wrong and many people suffer. The key is in devising and assessing definitive small trials.

Who does the assessment? It is often left to the ultimate bottom-line people, the financiers, the government and shadow ministry. And so it should be, in the long run the only thing that matters is the ultimate bottom line, did it work? If it did not work, these assessors are far enough away to simply terminate the people involved. However, the assessment of the people involved, and the blame, should be done largely by insiders who understand all the strands of the development.

The trouble is human nature again, those close to a project are unlikely to be objective about themselves. So a blend of those who know the project in its overall settings intimately, and moderators who are more removed and free to judge objectively, is of the essence.

Implementing overseas R&D

In addition to benefiting from its own innovation, Australia has to benefit to the utmost from overseas innovation - that other 98% of world activity.

Manufacturing here under foreign control also develops skill bases in Australia, and national policy should be to increase Australian ownership, management and improvement of this manufacture, as well as maximising offset R&D and manufacture.

Australia has one benefit in smallness and isolation - it is in many cases, not all, relatively easy to negotiate Australian licences for foreign inventions. Distant companies do not want to expend the time, effort and money to develop our small remote markets if it is not straightforward. Australian exporters have had to get used

to the distances to USA and Europe, while they do not have to accept the inconvenience of coming here.

Education in innovative culture and management

It is vital that state and Commonwealth governments encourage the introduction of teaching of innovation culture from primary schools through universities. The teaching profession is not noted for its understanding of or support for industry or management of society - how could it be? Teacher extension courses/conferences are important, but all school and university systems should be cooperating with industry bodies to have appealing industry spokespeople trained and allocated to provide study materials and lectures to students every year from about age 10 through to graduate schools. One of the best ways to support industry is to teach the most fascinating part of it - innovation - and inspire the next generations of managers and researchers.

Management schools and institutions need to be encouraged and funded to increase and greatly improve the teaching of the management of innovation. Research into innovation is also too general. There needs to be a concentration on very successful innovative organisations and how they do it, and as local as possible. Studies of huge organisations in the USA and Europe are not too useful for SME's in Australia.

Innovation is or should be the most democratic of industrial processes. Good technical and management ideas spring from all angles and all levels. It is no use teaching innovation to managers who do not know how to marshal the ideas of all their people into productive processes, review and continuous improvement. Innovation flounders within the culture of the majority of organisations, that is why it is not more common. It is not in the stars or strategy but in how we manage all ideas, incisive project review, position papers and meetings that innovation thrives or not.

Removing impediments to innovation

The greatest impediments are two:

- the continuing promotion of managers on the basis of being powerful personalities, or whom they know, rather than for general management ability, and the ability to manage innovation and change
- the proliferation of bureaucracy, planning layers and paper work above those who know what to do and try to do it. See Fig 2.

paper work of planning and review is another good plant gone to weed. It is necessary but overdone. Both slopes of the curve apply, and one of the most basic innovations in Australia would be an attack on overloading in planning staff, review and paperwork. Too many administrators and too few technicians. Make the line managers work effectively in the first place, rather than appointing layer after layer of administrators and planners above them, and reviewing twice as often as required, by another lot of non-hands-on bureaucrats. Business has wakened up to this and become leaner at the top (often more a slogan than reality, outsourcing at more cost than formerly doing it in-house) but the public service and universities are getting worse. Close involvements across Australia show much public administration to be somewhere between poor and a scandal, despite the efforts of thousands of good people and some fine departments.

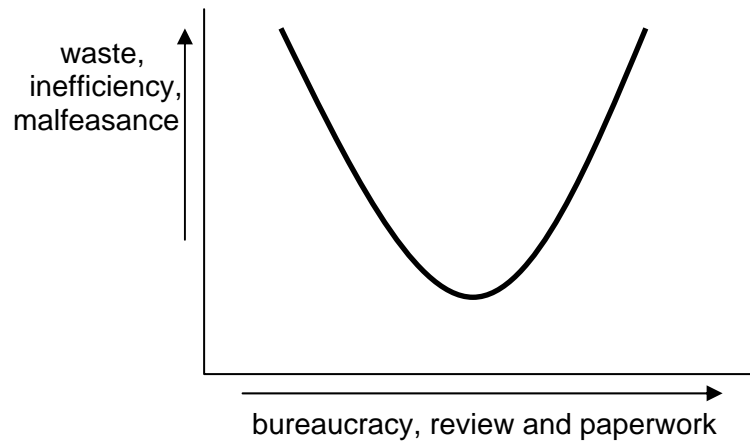


Fig 2. Inefficiency against paper work.

In universities, professors are not noted for good management, but nevertheless are there mainly to teach and research. The problem is mainly above them, in the hallowed halls of deans, DVC's, VC's and the senates and Chancellors - something out of Dickens. They get many big ideas right, and parade them, but implementation is another thing. Most, not just some, do not know how to manage people or systems, their structures are wrong, they lack transparency, treat in-group knowledge as power, do not know their finances except relative positions in securing funding, congratulate themselves, rort reviews into glossy self-justifying booklets. Proven bad administrators but top networkers are appointed to the top review levels in the land. I cannot give any of eight universities a pass mark in administration, large numbers of insiders agree but feel powerless, and the problem must be wider than those eight. I urge my criminal friends to defraud universities, it is so easy. Likewise for many public services, where a dynamic director-general who elicits commitment from all the staff to continuous improvement, who knows his policy is excellence, and who knows the business of that organisation from the shop floor, is the exception. Why?

Teaching and inculcating lean effective management attitudes and systems would do as much as any other measure for innovation in Australia. Abolishing the Australian Journal of Public Administration would help, it is a prime example of a review mentality gone wrong.

Research and Development Institutions

Companies and public service departments: These are put first because it takes organised teams in the commercial and political world to innovate.

While decisions and strategy for public innovation are finally the province of ministers, the public service has a huge role in developing innovation strategy, and in implementation. Across Australia, public administration is in dis-array, public affairs and departments are too complex to manage without going back to basics, and no-one has time for that. Irrespective of party in government, public administration is in crisis, and for obvious reasons.

It takes a small book to say how companies and departments should manage innovation, the problems are as wide as the industries and social groups they serve. For now, emphasise the essential pillars of success:

- **customer focus:** too many organisations are absorbed with internal issues. Astute matching of the user pull of customer needs with the product push of the innovation
- **organisation culture** of mutual commitment to customers, each other and to excellence, to the best personal and group values and to success; then confidence, generosity and creativity (the crucial soft elements), determination, rigour and decisiveness (the crucial hard elements)
- **key management processes:** team selection, meeting management, position papers, all-level project review, a modification of de Bono's thinking hats review process, delegation, reporting. These processes can be deadening or invigorating
- **a strategy** in practical words and measurable steps that melds the innovative potential to customer needs and company capacity, and that takes account of all relevant competition, allies and enemies
- **expertise base and promotion on merit** - practical and demonstrated by results, in this field
- **finance.**

To fail significantly in any of these six pillars is to fail overall. Many managers can check on the strategy, structure and finance, though they are tricky, but we often fool ourselves about our expertise, and claims regarding culture are generally suspect. All management systems and processes fail without the right culture.

Universities

I have worked with university research across Australia and sometimes overseas in many fields for over 40 years. In the last 15 years I have worked closely at times with 8 universities, none of the small regional ones. Our main universities are doing a mixed but good job in teaching and research though there are inevitable rorts and weaknesses. The freedom and peer review of research are time-tested.

The research systems and productivity need more penetrating review, but the main job is to reduce administrative load.

To fix administrative problems the only solution is more separation of specialist management of the administration from management of research. The problem is that universities will make the administration another fat bureaucracy with overlap between them and the management of research.

The malaise of modern management consists mainly in assuming that problems can be fixed with extra layers of review, planning and administration on top, rather than requiring those in management to manage well without all that superstructure. It adds muddle, planners talking with planners, diversion from serious work, and gloss.

There needs to be a simplification of structures, fewer levels, transparent decision making, and a wholesale cleanout. Senior university people are very bright, live and die by demonstrating their smarts, and can argue their way out of anything. Any internal or external critic is accused of not knowing the "real situation" and they keep that situation hoarded close to their chests for just that reason.

A 20% freeing up of administrative funds is possible - at least. In far better run places we have achieved more than that.

The plethora of institutes within universities now is probably inevitable, creates many frontier disputes with other departments, but does produce groups with real innovation. It is also politically astute - government funders can understand, name, open and visit a heap of bricks and laboratories; it is the word made flesh, or more to the point, public relations made brick. It will be interesting to see how most of them started in the last decade or so work out - measurement of success takes time, and the PR campaigns by the institutes muddies the waters.

The idea of concentrating government research funding in proven top research universities is sound despite the angst and the relative down-grading of minor and regional universities. It makes those smaller institutions more aggressive, creative and even more customer-oriented to raise non-government funds - so no bad thing.

CSIRO and Geoscience Australia

Both of these have been through so much political review that they cannot be blamed for the re-badging and promotion of major programs that have little to do with real performance of those programs. It has seemed that the BMR/AGSO/Geoscience Australia, with clearer and simpler roles and goals, and very practical industry-trained leadership, has done better than CSIRO in recent decades.

We honour the CSIRO, a wonderful institution. CSIRO has in my experience done outstanding work but also burnt off generations of researchers by bad internal management of teams. It also lives by the "not invented here" principle, and does too much border protection. The cynicism over decades is striking. For all their emphasis on commercial research, it is impressive how little many top researchers and managers know of the real world in the industry they serve. It is also uncommon to find a senior manager who takes seriously the special management of R&D. They mostly have a few slogans or aphorisms to guide them. The industry advice panels work fairly well.

These institutions need major reviews about every 6 years, rolling six-year indicative budgets confirmed every 3 years and a bipartisan understanding that continual political re-targeting, review and budget change are counter-productive.

The CRC system

The system has a sensible basis and philosophy, many very capable and wise people throughout, and is a credit to Australia. The balance between public good and commercial research has overall been understood fairly well, and some imbalance either way for five years or so is not a major concern.

The system is a bit stodgy, self-congratulatory, heavily bureaucratic, and administration could be trimmed 20% without loss of productivity or of integrity of the system. It has become a legal plaything and a milking cow for the legal firms involved.

Much of the spark has gone out. It is instructive to consider the Medawar curve, Fig 3, for R&D outputs against newness and difficulty, and time. When a great research idea, or institute, or R&D system starts out, it is very new, difficult because many big factors are as yet unknown, in fact it is a voyage into the unknown, with goals important enough to justify setting out - like Columbus. Output takes time to develop. Then as we hit our straps, there is a cascade effect, research leaps over the early hurdles, makes breakthroughs, and there are some years of great productivity. But with more time, the creative impetus is lost, the obvious has been done, the

productivity dies out. Sometimes it is nothing more than the burn-out of the great founding individuals. Individual CRC's are rarely given more than two 7-year terms partly because of this tendency, mainly to force them out to find finance from sources other than government. However the overall CRC system is also sliding down the right-hand side of the Medawar curve.

The system is so important it should continue, but with renewal. One way to enliven the system is to have two chosen young representatives from each CRC meet yearly in an invigorating week-long seminar with leading researchers from around Australia and the world, including Nobel prize winners, specifically to spark ideas off each other. It needs a bit of preparation, including requiring all participants to submit what-if proposals in advance; it needs some structure and facilitation, and a practical bent to guide the speculation. These young people would go back to spark their own CRC's. The cost would be tiny with respect to the average ~ \$700 million annual cost of the system.

The whole CRC organisation should consider the implications of the Medawar curve for them every three years.

The CRC system is subject to separate review.

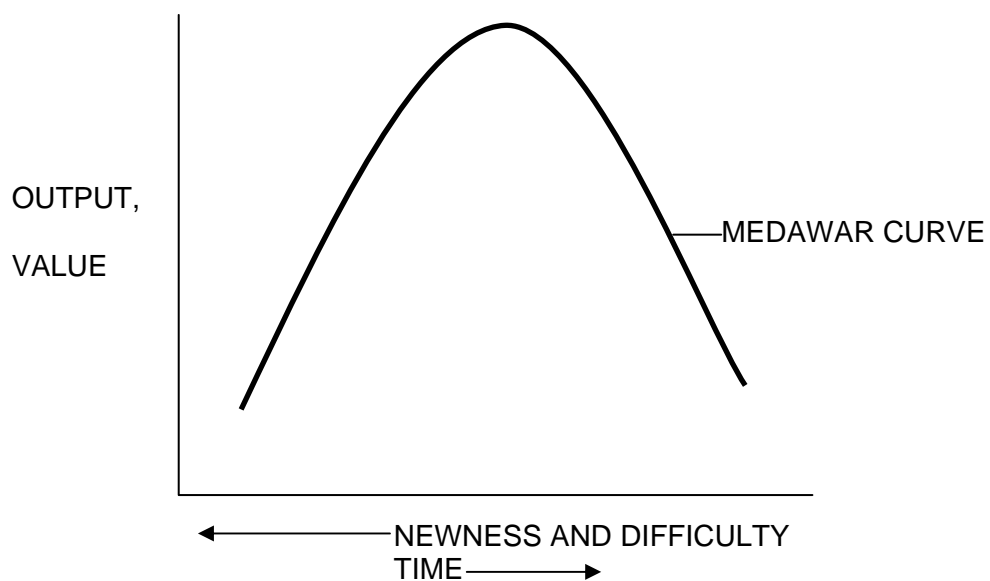


Fig 3. Medawar Curve

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