Extract from talk on

# “Solving the water Crisis’

# Part 1  The effect of Organisational structure on water management

Colin Austin March 2006

# Utilising our untapped water resources

## *Plenty of water*


Each day, on average, the rainfall per person approaches a million litres per day per person.

Australia is not short of water, we have more per head than most other countries.

Yet we daily hear of the water crisis, how towns like Toowoomba and Goulburn or facing the severest restriction ever, how farmers' entitlements are being cut and of course that ubiquitous catch phrase; - Australia, the driest inhabited continent.

We like our myths and respond to spin but the fact is that we have plenty of water. We have to stop and ask ourselves why, what is going on here?

## *Why we have water shortages*

The simple answer is that out of every 2,000 litres of rain we only harvest 1 litre in our system of catchments and dams. But simple answers rarely tell us the truth so we have to ask why we only harvest such a small proportion of the rain that falls.

The answer to that question is at two levels, the first is at the technical level. While it is true we have plenty of rain we also suffer very high levels of evaporation. Over much of Australia evaporation far exceeds rainfall. Even after just a few days of high evaporation the top layer of soil will have dried out.

Any small rain will simply be absorbed by the soil and there will be no run off, it will take either a heavy rain or a period of rain for the top layer of soil to become wet and for any run off to occur.

Our current technology of large dams means we can only catch rain in high rainfall areas with suitable terrain for building these large dams. This means we catch our water in mountainous areas with high rainfalls. Our catchment areas are a very small percentage of the total land area (in fact Australia is one of the few countries which has the luxury of dedicated catchment areas) and of all the water that falls in our catchment area we only catch a small percentage;- the heavy and prolonged rains which give us run off.

Yet most of Australia is relatively flat and much of the rain that falls is in small rains which does not give run off but largely evaporates away without being useful.

There is a fine balance between rainfall and evaporation. A small drop in rainfall (which is usually accompanied by an increase in evaporation) has disproportionate effects on run off and water collected in dams. In a marginal dam a 10% reduction in rainfall may reduce run off by 20%, a further 10% reduction my reduce runoff to 50% and a further 10% reduction may mean no run off at all.

A drought means a lack of useful rain; it does not mean there is no rain at all. We need a heavy rain followed by a series of follow up rains to get run off. In a drought there may be perfectly adequate rain to supply our needs but we fail to make use of the rain that falls which is simply lost to evaporation.

I have split this talk into two parts, the second - technical section looks at technologies for making use of these small rains. There is no real debate about the effectiveness of these technologies; many have been around for years, they work and are relatively cheap, amazingly cheap in comparison with the capital and running cost of, for example, a major recycling or desalinisation plant.

Yet our institutions responsible for water have not adopted these technologies; far from it, when they have shown any awareness of these technologies they have often been directly opposed to them.

In this first part of the talk I want to look at the complex issue of what has to be done so these technologies can be adopted, and this needs some preamble.

## *Levels of answer*

Let me start by telling you a John and Jane story. Their laundry tap was leaking – why? The simple technical answer is that the tap needed a new washer. A perfectly good answer; - at the technical level - but not the real reason.

John was fastidious about changing the tap washers, as soon as he saw a tap leaking in the kitchen, bathroom, or out in the garden he would fix it. So why was the laundry tap leaking?

Well John thought he was pretty good at working the washing machine, but Jane didn't. He would just throw the red towel in with the underwear, leave the pockets full of tissues and out came poor Jane's underwear, a nice shade of pink and covered in shredded tissue. So John was banished from the laundry and never saw the leaking laundry tap.

Jane got mad with John for never fixing the leaking tap, that was Johns job, not her job. She never thought to tell him about it, after all that was his job, and he should know the tap was leaking.

The problem arises from the system! This wonderful world of water is full of these situations, most people are doing their assigned job well and if it is not their job they assume that someone else is taking care of it.

## *Behaviour of systems*

The behaviour of systems is the real reason underlying why we appear to have water shortages when the facts show otherwise. Systems for the delivery of water are incredibly complex, involving all three levels of Government, Federal, State and the Local Councils. The mechanics of water delivery are entrusted to the Water Authorities, who have a theoretical responsibility to the State Governments, but as they generally have the technical expertise which the Governments do not have, it makes control somewhat nominal.

Then there is a whole assembly of research centres, from the CSIRO, Government Departments, various C.R.C. and the Universities all pursuing their particular specialities.

So where do we look for help in understanding the system problems in the water industry? Probably the automotive industry is a good starting point as the car industry has undergone some dramatic changes in its approach to systems.

## *Hand, mass and lean production*

This is well documented in a singularly interesting book “The Machine that changed the World’ which is really about systems. It starts by describing the first generation of technology; - the early days of hand built cars, then moves onto the second generation of what we often describe by that rather woolly term - mass production. The third generation is now widely referred to as ‘lean’ production.

Our shortage of water is directly linked to the failure of our water industry to move from the second to the third generation (lean water).

Mass production was made possible by the development of inter changeability, making components which are adequately accurate so the final product can be assembled from any combination of parts without individual fitting.

This enabled the adoption of ‘reductionism’ - breaking a large project up into smaller projects allowing individuals to specialise and become more effective.

# *Reductionism*

The theory of reductionism may seem a dry and academic subject to introduce in a talk on the very practical issue of water, yet it is at the heart of our water shortage problems.

There is nothing wrong with reductionism. It is the basis of modern society; it provides untold wealth and is the basis of all modern science.

It is not new; it was the basis of Adam Smith's thesis of economic production as highlighted in his pin factory. But it goes back much further; all the early civilisations from the Sumerians onwards were based on reductionism, with specialists in farming, making weapons or building roads, dams and viaducts.

Failure comes when the processes are no longer appropriate.

The Chaffey brothers irrigation systems and the Snowy scheme fifty years later, were dramatic pieces of engineering, and appropriate to their era. But the situation changes as the need for managing the water as a multi faceted asset becomes apparent and institutions struggle to adapt to the changed circumstances.

Simplification, omission and diverted loyalties are common weaknesses.

Complex tasks are simplified so they can be broken down into their components which can be worked on by individual or small groups. In this process of subdivision key areas are often missed. Or more commonly additional tasks arise which need to be done, but the organisation is not redesigned to incorporate or handle these changes.

Most damaging of all is the diversion of loyalties. We are talking about people and in a reductionist organisation people work in a hierarchy of sections, departments and organisations or institutions.

Each individual's loyalties is focused on satisfying the immediate needs of their group. They may feel that these immediate aims are not in line, or may be in conflict, with the overall aim, or National interest. A water authority's job is to deliver water as cheaply and effectively as possible. That may have been the original objective and defined by legislation. Now that simple requirement is no longer in the National Interest.

It is very rare for an individual to express views against their immediate grouping. The life of a whistle blower has never been fun.

## *Integration*

Reductionism requires that there is integration of the whole operation, what is popularly called leadership.

The really successful societies learned these techniques of integration. The Roman Empire had its specialists but successfully integrated these into a functioning whole. In its most successful period the rank and file of the Roman army was not based on Romans at all but on soldiers from captured territories who had been 'integrated' into the system.

The empire of Genghis Kahn had developed technologies such as the reverse tension bow and the stirrup, which enabled their horsemen to cut down enemies from a safe distance well away from the limited of their range of their opponents' weapons, (an action regarded by their enemies as unsporting in the days of chivalry). But their real strength was the integration of numerous previously small and warring tribes.

These civilisations, however successful they had become, simply disappeared into oblivion when they failed to operate as an integrated whole. So where do we look to learn about this process of integration?

The lessons on systems and integration from the car industry are highly relevant to our current water problems.

## *Lean production*

After the Second World War, with cold war tension with the communist block the Americans were anxious to revitalise Japan into a strong economic democracy.

'The machine that changed the world' tells the story of how Japanese engineers visited Detroit to study the American auto industry. They were overawed by the scale and sophistication; huge rows of presses dedicated to mass producing individual parts. Their immediate reaction was there was no way they could compete with that level of automation.

The Japanese only had a few presses to make the variety of parts needed; they had to make continuous tool changes, resulting in short production runs; - far less efficient than the American factories, with their dedicated presses in continuous production.

But then the Japanese studied the huge infra structure to handle the parts; - large ware houses with, in those pre computer days, an army of clerks checking parts in and scheduling them out, to meet the needs of the assembly line. This system was not just inefficient it often resulted in poor quality with much scrap or rework when the inspection system allowed the ware houses to be filled with sub standard parts. Defects were only discovered much later on the production line.

The Japanese set about redesigning their systems to ensure the overall system was efficient, what we now refer to as 'lean production'.

They introduced such techniques as 'Just in Time' manufacturing and quality control of the process. Interestingly many of these ideas came from America, Deeming the farther of on - line quality control was an American professor largely ignored in his home country until his ideas had been proved in Japan.

Quality is a just an example of 'lean' thinking. The Americans had an inspection system which did just that, inspect. Typically isolated from the production department (to avoid pressure and compromise) the aim of inspectors was to pass or fail or sort good from bad.

If a process was out of control producing bad parts, there may be a significant time before the problem was identified and rectified, and hence many bad parts were produced. The Japanese viewed this role of inspection as wasteful and incorporated the role of inspecting into the production process to ensure the process itself was in control, rather than use inspection as a way of sorting good from bad.

The Japanese had clearly understood that just making every part of the production process efficient did not automatically make the total process efficient. They realised it may even be beneficial to sacrifice efficiency of one part of the system if this makes the whole system more efficient overall.

Lean production is rightly regarded as the third generation of manufacturing technology.

## *"Lean" water*

The problems with the water industry are totally analogous to what happened in the car industry. There are many players in the water business; each component may be efficient but the system as a whole is far from effective.

What can we learn from the car industry about adoption, making that change from mass production to lean production? Initially the American auto industry totally ignored what was happening in Japan. And why not, American production methods lead the world. It was the massive productive capability of the American manufacturing industry, the ability to produce tanks, planes and ships faster than they were destroyed which was one of the key factors in winning the war.

America dominated manufacturing industry; surely they were entitled to believe their way of doing things was the right way.

But the Japanese industry totally outperformed the Americans. They produced the sorts of cars that people actually wanted to buy and the quality and price were far ahead of anything the Americans could offer. The American industry only adopted ‘lean’ production when their home market was being ravaged by imports.

The water industry is going through an analogous transformation to adapt to the changing circumstances. Let us hope that we do not have to have the equivalent of the major crisis that the American car industry suffered for us to make the change to ‘lean’ water.

# *Key points*

## Adequate rainfall

We have a perfectly adequate rainfall, approaching a million litres per person per day, our problems with water shortage arise because our current methods of water catchment involving large scale dams filled by run off only catches 1 in 2000 of the litres of rain that fall. This low harvest is linked to our high evaporation which dries the soil and restricts run off.

## Technologies exist to harvest more rain

There are technologies available for harvesting the lost rain (described in Part 2 and shown on the enclosed DVD 'Solving the Water Crisis'). They all have the common feature of catching and storing the water locally, specifically underground, protected from evaporation.

## Preoccupation with large scale mega project blocks adoption

One major hindrance to adoption stems from the structure of the water industry Our current water industry normally operates on a large scale, involving mega projects, building new dams, desalination or recycling plants costing millions of dollars.

Water harvesting is essentially a local operation, leading to a multitude of small scale low budget projects which has little appeal to the large institutions The infra structure to harvest this unused water would consist of a large number of small local systems, possibly run or at least overseen by local councils, a total contrast to the current large scale institutional water systems.

Institutional water corporations are not likely to be favourably disposed to these small scale systems which they may well perceive as outside of their control and possibly in direct competition with their activities.

## Threat to revenue streams

There is huge investment in the major water projects, which is paid for (in part) by users. Local water harvesting poses a perceived threat to the revenue streams. This is clearly not in the interests of water authorities, and to a lesser extent some State Governments who derive significant revenue from their water activities.

## Over the wall

Our current water industry is fragmented, stemming from the reductionist approach. There is no nice little neat box in which water harvesting can be placed, so the project is just tossed 'over the wall' to some other department and no action is taken.

## Lack of incentives for the private sector

Commercial companies are often far better at promoting new technology but in this case there is a problem that the systems are very cheap,, most components can be purchased locally, so there is little incentive for any commercial organisation to take the initiative in promoting the technologies.

The benefits flow to the community as a whole (in terms of a sustainable water supply) rather than to the providers of the systems.

## *Solutions*

So what is the solution? It would be nice to think that the lessons of lean production and the recognition of the need to have a more integrated approach would be rapidly adopted by the water bureaucracy. This process is already under way but the time scale for such a change is not on our side. It took the American car industry decades to totally adapt to 'lean' production.

We simply cannot wait for these major structural changes to occur in the water bureaucracy before we start harvesting our under utilised water.

These underlying but slow structural changes will help to create the environment for change but we need to look for a fast track approach.

Where do we look for inspiration? Undoubtedly the PC is one of the major revolutions and is a good place to look.

I.B.M.'s management realised that there was a need for I.B.M. to take the lead in the burgeoning personal computer market which at that time was fragmented, with no standards and not really quite making it, but full of promise.

I.B.M. well understood the lessons of lean production. They were the world's largest computer manufacturer, a huge company with a dominating role in the large main frame business with all the problems of system design. They realised that trying to form a PC division within any of their existing divisions would result in the established bureaucracy smothering the new baby.

Existing division were more interested in selling a high tech million dollar system than what hey perceived as a toy, analogous to the current local water harvesting situation.

Instead they picked some of their best people, formed them into a small team, essentially a ginger (or moonshine) group, independent of the other divisions but with the support of top management. They were essentially set free and told to do what it takes to make it happen.

The result is obviously one of the great success stories of modern technology adoption, (although no doubt I.B.M. may have liked to have a bigger slice of the final pie). But it must be said that if I.B.M. had not taken the decision they did to adopt open standards it is unlikely that we would have had the current computer revolution.

This approach provides a model for how to ensure the water harvesting technology achieves wide spread adoption.

The analogy in the two technologies is remarkable.

Take the industrial structure. Prior to the P.C. the computer market comprised a few large organisations, all focused on the grand schemes; - bigger and better computers and were totally ignoring the small end which was almost beneath their dignity. That market was left to a handful of also rans, little more than back yard outfits run by hobbyists.

Yet after the revolution P.C.'s dominate the computer market with the large mainframes assigned to a relatively few very large applications.

This is what we have in the water industry, very large organisations focusing on the grand scale projects ignoring the much greater potential of the multitude of smaller water harvesting projects. We are currently only utilising a minute amount of the water that falls as rain. The potential to harvest water from currently untapped sources would increase our water availability many fold.

But how do we make this happen, who should initiate such a move? The reality is that the only the Federal Government has the capacity to take the initiative.

There is already a wealth of resources available to be integrated into the project once started, for example the C.R.C. for Irrigation Futures has the technical expertise to undertake research and local councils have the resources for trial projects.

Later on local councils are most likely to become the major managers, promoting, providing technical advice, approving sites, giving planning permission, etc. But they will need formats to work to and guidance in setting standards.

But none of the existing institutions is suited for taking that initial lead role. Only the Federal Government can set up this lead group. The role of this lead group, called say the' Water Harvesting Group', would essentially be co-ordination. They are the pioneers who could make it happen, largely using the wealth of existing resources. They would ensure that the technologies are refined and documented, standards set, demonstration projects established etc.