# WHY OPERATORS SHOULD BE INVOLVED IN DESIGN

***Paper Presented by :***

**Rex Foale**

***Author:***

**Rex Foale,** *Director*

GHD Pty Ltd

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**Rex Foale**, Operations Supervisor, GHD

## ABSTRACT

The "lynch pin" in any Treatment Facility is the Operator. "Ownership" of an operation is the key to the economical functioning of the plant. Ownership will only develop if the Operator is permitted to have meaningful input into all phases of the design processes. Management must allow the Operator to spend considerable time participating in all aspects of the design through the concept development, design review process, Hazops, construction and commissioning phases. The cost of this time can be returned in full over a very short operating period.

## KEY WORDS

Design, Operator, Function, Efficiencies, Performance, Ownership, Pride.

## 1.0 INTRODUCTION

How often have you heard the saying, "The "suits" have left the job. Now I'm left to make this damned plant work." Operators who feel they have been bypassed in the process of creating the project they now are expected to run at "world best practice," have a right to feel aggrieved.

There will be aspects of the plant that they are not comfortable with, simple things such as the location of the carpark and positioning of the night-lights or something more serious. Perhaps no one bothered to make sure the Operator completely appreciated the processes and functions involved in the plant, or understood how these were to be implemented and controlled.

## 2.0 THE STARTING POINT

The Operator is often the forgotten ingredient in the formula used for the design of a new or upgraded water or wastewater treatment plant. The design of a capital works project is normally developed as a result of changes in the demand for treatment, population changes, legislative changes requiring improved water quality outcomes, a new industry moving to the supply area and community expectations.

The physical manifestation of the design frequently develops as a result of these requirements in a process of collaborative input between the designer and the client and some times will include community consultation.

The detailed design may also develop in effective isolation as a BOOT scheme or a Design and Construct contract.

All too often the Operator is not involved to any great extent. After all, they have been employed to run the other existing plants and must therefore be too busy to take time off from their duties to attend meetings on a regular basis, or to wander for hours around a construction site. This costs money and there is no direct return obvious to those responsible for containing costs and establishing KPI's and other bench marking criteria.

Often then, the Operator is afforded only a cursory involvement, which is frequently considered sufficient.

## 3.0 THE FICTION

Didn't the Authority spend a lot of money training them to be fully-fledged operators? Don't they now possess the necessary skills to trouble shoot a Hi-tech plant brimming with computers, PLC's, SCADA systems, complex chemical processes and innovative technologies? The Operator should

be able to take all of these issues in their stride. As a result of all this training, they should be capable of running the plant after a few hours of on the job training from the commissioning staff !!

If you have never had the opportunity to observe the processes of commissioning at the end of a job you could be forgiven for thinking this would be the case.

## 4.0 THE REAL WORLD

In reality it is far from that simple. It frequently takes a large site team of fitters, engineers, chemical engineers, software and communication engineers, (often working by remote means) and other trouble-shooters to solve a whole raft of problems. Frequent physical and chemical changes, many weeks of hair pulling and vast amounts of money may be required to commission a plant and have it run within the parameters required in the Contract. Optimisation of performance will usually take longer.

Frequently the designer is an office-based worker sitting at a CAD machine. Very good at drafting, but often with little site experience. The more experienced project manager with the responsibility for checking the design is usually very busy, and their charge out rates are high. They cannot afford the time to check perhaps dozens of design drawings for all the little operational issues that would make life easier for the Operator so they concentrate on such items as architecture, structural adequacy, hydraulic suitability and electrical and control systems.

I remember the first water facility that I helped design quite some years ago. It involved three 600 dia. high-pressure water sluice valves. I had been an architectural design draftsman for 10 years but to me, these valves were simply crosses on the drawing.

When they arrived on site and the docket indicated they weighed about 4 Tonne each, I looked at the position they were to installed and wished I had designed the pipe work so they would be under the 10 Tonne gantry crane that ran the full length of the building.

**Figure 1:** ***4 Tonne valves - snugly installed under the mezzanine floor.***

## 5.0 THE DESIGN REVIEW PROCESS

The formal review processes conducted through the design phase of a large project are frequently rushed. Other issues such as contractual matters and the finances of the job tend to take priority. When a review meeting is held, the language is full of engineering jargon and technical terms that are only fully understood by highly trained personnel.

The time seems to disappear before operational issues such as access for taking samples, access

for servicing of equipment, handling of heavy items, working spaces around equipment to enable dismantling and repair can be addressed.

**Figure 2:** ***Space limitations means more equipment is required to manoeuvre heavy objects***


As a result, deficiencies in the design can slip through the review process only to be found by the Operator when a problem arises and the design causes complications during rectification works. How often is it found that to remove a pump shaft some other machine has to be moved ?

Simple issues such as the provision of power outlets for power tool use around the plant, sufficient hose points and pressure for washdown, adequate lighting to enable complicated repairs at night.

Walkways often have steps and sharp changes of direction that make manoeuvring of wheelbarrows and trolleys impossible.

Even though the width of a walkway at 600 mm is wide enough to allow people to walk along them, it makes it almost impossible to carry buckets or tools on them. Speaking to school groups etc, requires a very loud voice to reach the people at the back.

**Figure 3:** ***Nice, but narrow walkway***

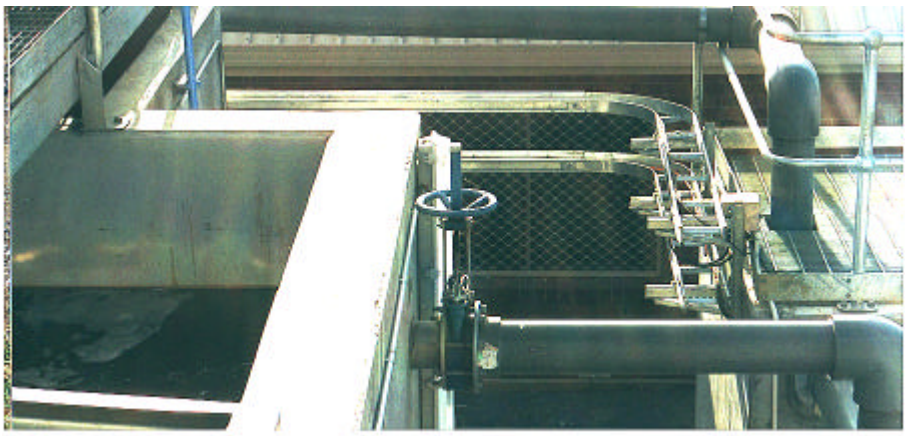
One simple feature often overlooked is the provision of drain valves and the controlled discharge of drainage from tanks. A tank may only require to be emptied once a year or so but the use of pumps in above ground tanks and running of hoses to a safe discharge point can be a heavy and frustrating job that may take days to oversee, moving pumps about, re-fuelling, cables, generators etc. A valve and drain may only cost a few dollars, pumping can cost many dollars every time.

**Figure 4**: ***Not the fastest way to empty a tank of sludge***

Have you ever tried to carry a toolbox, or anything at all for that matter, up a vertical ladder? If you have, you quickly realise why they are not popular.

**Figure 5:** ***How many hands are required to climb a ladder and carry a toolbox ?***

**Figure 6:** ***Access to this valve may be classified as less than ideal***



## 6.0 TRANSITION TO NEW TECHNOLOGY

It should be remembered that there are many operators in the industry who have previously worked as truck drivers or mechanics or on pipe maintenance who are now being expected to run very sophisticated technically advanced treatment plants.

For those not familiar with them, SCADA systems can be daunting. The thought that someone can run a treatment plant from their bedside table takes some getting used to. Control Systems should therefore be set up in the clearest format possible and provide all the information that the Operator requires. User-friendly systems are essential.

While this approach makes an experienced Operator's life a little easier, it also makes the training of a new Operator a much simpler task.

It should be remembered that Operators can get sick, take holidays and sometimes take RDO's. The replacement Operator may not be as familiar with the installation and in an emergency has to be able to take over the operation immediately. It may be that the replacement personnel are from the office and may have only visited the plant occasionally.

The procedures to operate the plant effectively therefore must be as simple and clearly documented as is practical. Every item should be fitted with a clear and fully descriptive label.

Another problem of significance is the geographical layout of the plant.

**Figure 7:** ***Not the best route to the filters. Noise in the Lab is a likely problem here***


It would appear little thought has been given to the distances and pathways an Operator needs to travel when collecting samples or inspecting the various components of the plant. eg. The door to

the office is frequently at the opposite end of the site to the entry door to the filter cells or the blower room can only be accessed by walking around a building, and/or, travelling through three other rooms. Over the past 2 years, I have visited a couple of dozen water and waste water treatment plants and found these types of issues to be present at all of them.

An Operator whose plant has a large number of these design problems will quickly become frustrated. It would not be surprising then if the performance of those plants did not consistently meet the required criteria.

## 7.0 OPERATOR INPUT DURING DESIGN AND CONSTRUCTION

It is essential that the project management team involve the Operator in the design process by facilitating specific operations-focussed discussion with the Operator. Input from the Operator must be given due recognition. It may not always be expressed in the most appropriate manner but the design team must persist until any suggestion is clearly understood. Operators must also persist until they are comfortable that their queries have been answered to their satisfaction. Everyone should also remember the old adage that there is no such thing as a dumb question!

Providing the suggestions put forward by the Operator are not outrageous, hey should be implemented. It is cheaper to widen a walkway by 150 mm prior to construction than to determine later that there are OH&S issues with what was built and removing, say, 50 metres, adding the required extra width, and re-installing the whole thing again.

There is also no point saying "yes" at these meetings and subsequently deciding not to proceed. The stories often heard are "When I told them, they said it is too late now the job is finished. It would be too expensive to fix now. Put up with it for now and we will fix it in stage 2."

It is true that many Operators are now given more exposure to the various stages of the design process these days. However, they can often be brought in so briefly that the matters under discussion appear irrelevant, too technical or simply boring.

Time may be too short, or management cannot afford their Operator to be away from their normal duties, there is always an emergency somewhere else that requires their presence. Management should make every effort to provide other staff to cover the time the Operator is involved in these sessions. I believe it is cheaper to spend the money now to have an Operator heavily involved in design than run the risk of them becoming uninterested, frustrated, confused, unable or unwilling to operate the plant at its full potential.

Arrangements should be made for the Operator to visit other plants using similar processes and systems and to spend time with the Operator of that plant as they carry out their normal duties. This allows the Operator to learn the idiosyncrasies of the process and systems and to become familiar with the methodologies involved. Overnight stays may be needed and more than one trip should be allowed for.

The Operator must attend site regularly during construction to witness how various components are assembled. This should be for a number of hours at a time as no one can pick up the knowledge required in 10 minute visits every week or so.

This attendance becomes more crucial during the final commissioning of the works. This is the time when problems with the new works are identified and corrected and attendance should be for whole days as appropriate to the work being undertaken at the time. Depending on the size of the project, this period could require the operator to be on site for weeks.

The knowledge of how problems are corrected is invaluable as the plant "beds in" and it enables the Operator to better describe the non-conformance to others during the defects period of the

contract, and beyond.

Contractors and engineers will have difficulty planning the appropriate corrective actions if the description of the issue goes something like this…… "What's the problem? ….It's stuffed!! …. What is really wrong with it?…..It's **really** stuffed !!

An Operator who feels they have been an integral part of the design and construction process will, I believe, develop a better understanding of the operational requirements of the finished plant and a better appreciation of their role in ensuring the plant always runs at its full potential.

Operators will be able to better manage the control systems as installed and be able to interpret the outputs of the many instruments included in modern treatment facilities. Operators will also feel more confident in handling any event outside the norm, and are more likely to make the right choices when they fully understand the purpose of the individual parts of the plant as well as the functions of the whole installation.

## 8.0 FINANCIAL IMPLICATIONS

Once the plant is operating under the control of the designated personnel, large savings can potentially be realised. Recent personal experience has shown that if the Operator has neither the time, understanding nor inclination, operational setpoints are often selected to cover the worst-case scenario.

Mechanical processes are often set at maximum, as this will get the job done faster. Running a plant beyond its optimum setpoints may result in equipment failure and fouling of equipment, tanks and other items that can inhibit overall plant performance. The resultant down time and the excessive number of call-outs may be expensive, not to mention the cost of a breach of the discharge license.

Adjustments to the plant are often re-active and sometimes to the extreme, with many parameters being changed at the one time. The end result is a plant that does not perform, and the reasons why are difficult to determine because of the number of changes, and the size of each change.

In a Dissolved Air Flotation and Filtration (DAFF) water treatment plant, large volumes of treated water may be lost through extended float and backwash times and associated flow rates. This is water that has already been dosed with expensive chemicals, electricity has been used to pump the water and excessive flow rates contribute to unrecoverable costs with each recycle.

The higher flows may also overload the sludge handling facility. Excessive dosing of Polyelectrolyte can lead to the blinding of the filter media. This will reduce filter run times and increase the need to backwash due to steeper headloss curves. This adds to the volume of lost treated water.

All to produce a "clean" tank surface when all that is required is to keep the blanket moving.

To put some of what has been said into perspective, a modern DAFF water treatment plant processing reasonable raw water will require, say, an Alum dose rate that will vary between 30 & 60 mg/L. I have found recently a number of plants regularly dosing at 100 mg/L and as high as 150 mg/L simply to cover fluctuations in raw water quality in order to minimise operator attendance and to avoid the need to conduct jar tests or to spend time adjusting rates to optimal levels.

## 9.0 POTENTIAL COST SAVINGS

At a plant with an average inflow of 10 ML/day dosed with Alum at 100 mg/L, this would represent an excess of Alum dosed of some 500 kg/day. Over a year, this is an unnecessary waste of about 180 Tonne of Alum, not taking into account the other products involved such as

flocculation aids and pH correction chemicals.

At current regional delivered prices this waste is in the order of $ 38,000.00 for Alum alone - sufficient savings to justify a higher level of investment in the operations staff before the plant is placed on line.

In wastewater tertiary treatment plants where the dosing rates are often much higher, more chemicals with higher purchase prices may be involved plus other materials such as flocculation aids, pH control and other proprietary products, the potential savings from optimisation of the plant performance become even more significant.

The potential costs of chemical wastage etc in a 20 ML/day tertiary wastewater plant could exceed $ 500,000 per annum. These surplus chemicals will usually be removed from the water stream as a sludge.

Treatment, disposal and the environmental aspects of such sludges are a matter for further discussion by others.

It would appear from the costs involved in water and wastewater treatment that a good Operator is literally worth his or her weight in gold.

## 10.0 CONCLUSION

I believe that a moderate investment in the operational staff who will be responsible for the direct operation of a sophisticated treatment facility will have the potential to provide large returns from process optimisation that can be many times the value of the initial outlay.

Informal training through the design reviews, construction and commissioning phases of a project, particularly when combined with more formal training in certificate courses tailored specifically for the industry, will also provide long term benefits for the employer on site and beyond the boundaries of the treatment facility.

## 11.0 ACKNOWLEDGEMENTS

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