

A tribute to Gustaf Olsson

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As I contemplate the organisation of this paper about the description of Gustaf Olsson's contribution to the world, I understand that the headlines could be many and remarkably varied.

From my perspective, however, four headlines stand out:

- Research contributions in the field of instrumentation, control and automation (ICA) and water
- Philosophical contributions to sustainable systems thinking in water
- Humanistic contribution from the heart
- Personal contribution to my life

These four key contributions only cover a fraction of Gustaf's contributions. They do not cover the contributions within the field of energy, contributions as an active member of International Water Association (IWA)/ International Water Association Publishing (IWAP), the political supportive contributions in for example Niger and to charitable organisations as Smile and Doctors Without Borders, his musical contributions on organs and pianos, his contributions as a husband, father, grandfather and great grandfather, his contributions as soul counsellor for hearts broken in many varied ways, his local church contributions, his contributions to Lund University and the surrounding start-up environment, his contributions to Universities such as Tsinghua, Queensland, Exeter, Laval (Quebec), his contributions to the students who's life he has touched – and to the many more people and organisations he has generously inspired and influenced over the years.

But so it is: not all can be or should be described.

14.1 RESEARCH CONTRIBUTIONS IN THE FIELD OF ICA AND WATER

Gustaf Olsson has been part of the ICA community in water from the early 1970s. Even though he started out as a student of nuclear technology with a

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specialisation in control, water is where his key contribution lies. After being asked his opinion on the opportunity for control in wastewater treatment plants in Sweden he turned to the topic of water and remained with that challenge from the 1970s and up until today. The first written reports on this topic were *Control problems in wastewater treatment* (Olsson *et al.*, 1973) and *Measurement and control in chemical and environmental engineering* (Olsson, 1974).

After these initial reports where he identified a clear potential, he progressed to deepen his understanding through papers such as *Modelling and identification of an activated sludge process* (Olsson & Hansson, 1976a) and *Stochastic modelling and computer control of a full-scale wastewater treatment plant* (Olsson & Hansson 1976b) and *State of the art in sewage treatment control* (Olsson, 1977).

Then he turned his attention to a key issue in wastewater treatment plants: the control of oxygen in the wastewater treatment process. This control not only handles both the performance of the biological processes, but also the energy consumption which received global attention during and after the years of the energy crisis in the 1970s. The research was published in papers named: *The dissolved oxygen profile – a valuable tool for the control of the activated sludge process* (Olsson & Andrews, 1978) and *Self-tuning control of the dissolved oxygen concentration in activated sludge systems* (Olsson *et al.*, 1985). Then he turned to the difficulties of controlling the clarifier with the paper *Modelling the dynamics of clarifier behaviour in activated sludge systems* (Olsson & Chapman, 1985).

In 2001, Gustaf presented his paper to the ICA community (Olsson, 2002) when it visited Malmö in 2001. A few years later in 2004, he lead the group of Ingildsen, Jeppsson, Kim, Lynggaard-Jensen, Nielsen, Rosen, Spanjers, Vanrolleghem and Yuan in an effort to summarise ‘all of it’ in a leading edge paper in Prague named *Instrumentation, control and automation – hidden technologies in wastewater treatment* (Olsson *et al.*, 2004).

The year after, he wrote the paper ‘*Plant wide control – dream, necessity or reality?*’ (Olsson & Jeppsson, 2005) to conceptualise a vision of not just managing various single-loop optimisations but to rather optimise all control handles and variables for an overall optimised plant performance.

Gustaf has been a professor in Industrial Automation at IEA (Industrial Electrical Automation) at Lund University since 1987 and continued this position until his retirement to Professor Emeritus in 2005. During this time countless students went through the courses that he taught. Gustaf wrote several books to teach and inspire his students. The key titles are the control technical textbooks *Computer Systems for Automation and Control* (Olsson & Piani, 1992) and *Industrial Automation – Applications, Structures and Systems* (Olsson & Rosen, 2005) and his books directed towards water and control, that is *Wastewater Treatment Systems* (Olsson & Newell, 1999), *Instrumentation, Control and Automation in Wastewater Systems* (Olsson *et al.*, 2005) and for practitioners *Get More Out of Your Wastewater Treatment Plant: Complexity Made Simple* (Ingildsen & Olsson, 2001).

It is difficult to capture the essence of Gustaf’s research in a few lines, but an attempt would be something like this:

Control and automation can be helpful in especially the following three priorities: keep the plant running, satisfy the effluent requirements and maximise the efficiency.

There are three key driving forces for control and automation in water, the foremost is a technical driving force, where sensors, actuators, control equipment and control algorithms has developed and become increasingly available since the 1970s and up until today. The second driving force is regulatory. In a sense there is a communication between regulations and technology as stricter demands provide a space for better technology to come and solve the challenge and as technology makes it possible to be more precise, regulation can be made more intelligent and complex to meet the environmental issues that the regulation is attempting to address. The third driving force is the human factor. Gustaf always insists that this field is about people. Clever process operators can make a plant sing, process educator without proper knowledge can make a plant crash. Hence motivation, training and experience are key.

Control and automation are about addressing various timescales in the different control loops. The key loops are dissolved oxygen and SS control, which are controlled in two different time domains. By means of models it is possible to make control much more advanced and taking care of all the interactions in the plant, the ultimate goal is plant-wide control. There are many clever control strategies and ideas, the key idea in control is however first and foremost feedback, that is, the ability to understand where the process is right now and act accordingly. The second most important principle is feedforward, that is, to understand where the process is heading and prepare the process to provide optimal conditions for high performance.

14.2 PHILOSOPHICAL CONTRIBUTIONS TO THE FIELD OF SUSTAINABILITY

The year 2005 marks the time when Gustaf retired from IEA. Gustaf had been a much-loved professor at the department, and I am sure he enjoyed his role. But at this point of time, he grasped the opportunity of being Professor Emeritus and the freedom to do the kind of research he personally felt inspired to do and that he felt was important. Hence, 2005 also marks a transition in his research efforts towards water sustainability and systemic understanding in a global context.

During these later years we have often discussed what it means to be a human being in this time. What is our duty and how can we succeed in changing the world from the perspective of sustainability and water stewardship – and how do we even interpret what we see? Gustaf has followed the environmental debate since before the Club of Rome.

Inspiring quotes from some of his preferred books on sustainability are: An attitude to life which seeks fulfilment in the single-minded pursuit of wealth – in short, materialism – does not fit into this world, because it contains within itself no limiting principle, while the environment in which it is placed is strictly limited.

From ‘*Small is Beautiful*’ (Schumacher, 1973).

The difference between a sustainable society and a present-day economic recession is like the difference between stopping and automobile purposefully with the brakes versus stopping it by crashing into a brick wall. When the present economy overshoots, it turns around too quickly and unexpectedly for people and enterprises to retrain, relocate, and readjust. A deliberate transition to sustainability would take place slowly enough, and with enough forewarning, to that people and businesses could find their places in the new economy.

From Limits to growth (Meadows *et al.*, 1972).

I said earlier that my first message to you is that the kind of leadership we have must be changed. The second message I bring you is that global warming is real. It is imminent. It is upon us. It’s a lot closer than you think, and I don’t believe we’re ready for what’s coming. from the speech ‘The ice is melting’ (Lyons, 2004).

In an incredibly short period of time we have endangered a world that took billions of years to evolve. We are just a tiny link in the great chain of living organisms, so who are we to put it all in jeopardy with our ecological blindness and deadly technologies? Don’t we have an obligation, a responsibility, to our planetary future and the generations of humans and other species to come? from The good ancestor (Krznicar, 2020).

He has expanded the systemic approach as the years progressed and still does. In his research more energy themes were included such as in the paper *Smart water and power grids – drivers, opportunities and challenges* (Olsson, 2011). However, most obvious is the transition to be seen in his book publications, which starts off with the best seller ‘*Water and Energy: Threats and Opportunities*’, which has been published in two editions. The book describes the systemic connections between water and energy, never before described with this conceptual clarity. The book shows ‘... how energy is used in all the various water cycle operations and demonstrates how water is used and misused in all kinds of energy production and generation. Population increase, climate change and an increasing competition between food and fuel production create enormous pressures on both water and energy availability. Since there is no replacement for water, water security looks more crucial than energy security’ (Olsson, 2012).

In 2016, Gustaf and I wrote ‘*Smart Water Utilities – Complexity Made Simple*’ (Ingildsen & Olsson, 2016) attempting to describe how far instrumentation, Control and Automation and other levels of digital intelligence could bring water and wastewater utilities in the direction of being smart – in principle regardless of overall goals, but with a nudge towards a water stewardship approach.

In 2019, Gustaf looked at how to provide water sustainably outside the power grid through using solar and power to provide water in the book ‘*Clean Water Using Solar and Water*’ (Olsson, 2019).

In 2022, Gustaf will have two books published on systemic understanding of the water system, *Improving Utilities with Systems Thinking – People, Process and Technology* with Cello Zdenko, Scott Haskins and myself is the first book and will be published as a collaborative effort between WEF and IWAP. The second book is his own *Water Interactions – A Systemic View* describing the evolution of the sustainability crisis over the course of his life from the 1940s until today followed by a recounting of the interconnections between the sustainability crises of climate, water, energy, health, economics and lifestyle.

An important insight from this work is that it appears that understanding control theory prepares you well for systemic understanding of larger sustainability issues. Which is also indicated in James Lovelock's Gaia (Lovelock, 1979), who's main thesis was that the world operates and makes the world inhabitable by means of a myriad of feedback loops that keep conditions balanced in such a way that humans and other lifeforms thrive – he may even indicate that the intricate interactions between these life forms are a major part of the intelligence that keeps the huge earth process or life process within the scope of Gustaf's three aims of 'keep the earth running', 'keep within regulatory limits (limits enabling life)' and 'do so as efficiently as possible'.

The books can be seen as a kind of dialogue he is having with himself and the rest of us about the sustainability crises and how they interact with our job as water professionals. Through his writing he is initiating a field of technical water sustainability understanding and emphasis mixed with moral understanding and a growing concern and alarm about the direction the world is heading in.

In this work he strikes both a moral and a technical chord – and we need both to succeed. We need to evolve from short-term thinking to long-term thinking and Gustaf is showing us how.

14.3 HUMANISTIC CONTRIBUTION FROM THE HEART

Even after these great contributions, I believe that at the end of the day, what most people remember is not the science, it's not the alarm rather it's his person and how he manages to make you feel. His distinguished personality exudes warmth, enthusiasm, passion, generosity, kindness, intelligence, ability to explain, ability to listen, grasp and appreciate your ideas and concepts.

There are many examples where I have experienced what he 'does to people' firsthand. But especially two episodes come to mind.

In 2017 he opened the conference 12th IWA Specialized Conference on Instrumentation, Control and Automation 11–14 June 2017 in Québec City, Québec, Canada by playing the most beautiful piano concert for an amazed audience of researchers and practitioners of ICA. It was as surprising as it was soothing and uplifting. After finishing he stood up and gave an inspiring lecture on the last 5 decades of development of instrumentation, control and automation and provided everybody with a vision of what he believes was to come in the near and not so near future of ICA. This uplifted the whole conference for a great both reflective and enthusiastic start of the conference.

Another incident, that illustrates how he can make everybody do their best through inspiration and listening, is from a workshop, I held at Kalundborg

Utility. The purpose was to develop an innovative drinking water plant and we had invited three professors from Denmark, Norway and Sweden – the Swedish being Gustaf. We had also invited a number of other internal and external project participants and stakeholders amongst which were the three key operators of the currently running plant. They felt a bit out of place in the beginning with the three professors, but whatever strangeness they may have felt was completely obliterated by Gustaf. In a short time, he changed the situation, so that the three operators became the lead actors of the workshop. He asked, listened and marvelled at the insights he gained from the three experienced operators. This meant that the project was profoundly inspired by their point of view and their concerns and aspirations. This turned out to be a great experience for everybody – and everybody learned something new in the happy, curious and constructive way that we all love.

I have experienced this magic many times with Gustaf. So much that at conferences I tend to find a place near Gustaf at lunch – just to hear the conversations that come out of it when he questions and thinks together with those, he has lunch with.

14.4 PERSONAL CONTRIBUTIONS AND INFLUENCE ON MY LIFE

Gustaf constitutes a whole part of my world to me. I often as a shorthand explain to people that he is like ‘a second father to me’.

I met him in Sweden in 1998 to discuss the opportunity to seek the Danish Academy of Technical Sciences to fund a PhD project on control of wastewater treatment plants using Danfoss’ newly invented in situ online nutrient sensors – having him in the central role as the supervisor. I didn’t know much about Gustaf besides having read a few papers. Little did I know what an incredible fortunate event it would develop into, that he happily accepted the task.

In 1999 we visited the Advanced Water Management Centre at University of Queensland in Brisbane. Almost every lunch we enjoyed together followed by chocolate topped with mini marshmallows. In the autumn/winter of 2000 we wrote the book ‘*Get More Out of Your Wastewater Treatment Plant*’ together. I did most of the writing and every Tuesday evening, I travelled from Copenhagen to Malmö to discuss the writing in the home of Gustaf and Kirsti.

By 2002 the PhD programme came to its end. I am not a lot into national symbols, but still I was moved when I realised that Gustaf had organised a Danish flag for the flagpole at the institution at the day of my defence.

Later we co-wrote the book ‘*Smart Water Utilities*’ and he was a tremendous support during the difficult writing of the Water Stewardship book – always encouraging the work and convincing me of its importance when I doubted. Still today we often have complex discussions of how to understand and work with water from sustainable systems view.

Currently, we are working on a project called Leap. The purpose is to develop leadership skills for a successful transition to a sustainable world. Until now, we only have pieces of the puzzle, but working with Gustaf, I hardly feel any doubt, that we will find a good way sooner or later.

But also, when it comes to difficult times in my life, he has been steadfast. He has been part of my life for more than half of it. Not a single time has he given me reason to regrets – except perhaps the one time where he could not stop laughing at my hysteria when a leech attacked my leg. It was my first leech and yes, I panicked. Even years ... decades later, he lets me hear about it. But that small thing is easily forgiven. The place where our lives intersect has always been wonderful and I am immensely thankful for all that he has been: a friend, a counsellor, a philosopher, a sparring partner, a cheerleader, a role model and a second father.

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