LEADERSHIP IN LEARNING: COLLABORATIVE APPROACHES TO BUILDING THE WATER SECTOR OF THE FUTURE

Embracing a time of change and challenge

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INTRODUCTION

We live in a time of change within the water industry. Across the sector pressure is growing to secure water resources in the face of climate variability and change; ensure sufficient water flows to support the health of inland waterways and coastal ecosystems; deliver resilient and affordable water supplies; recover energy and other materials from wastewater; better manage stormwater; mitigate flooding; and play a stronger role in enhancing the liveability of our cities. These pressures constitute strong drivers for transformation in our water policy, planning and management systems, and in the way we think about and use water for different purposes.

We have previously articulated the challenges of developing skills and knowledge profiles in the workforce of the water sector to enable the implementation of transformational change while ensuring high-quality basic services and functions are delivered cost effectively (McIntosh et al., 2013; McIntosh and Taylor, 2013). The kinds of T-shaped, leadership-oriented professional skills profiles that we have argued will be needed for effective transformation are different from the kinds of narrower, specialist ‘I’-shaped skills profiles that are needed for effective delivery of basic services and functions.

The water sector needs both kinds of skills profile in the workforce, but as a matter of some urgency needs to develop enhanced capacity to innovate as the basis of responding effectively to transformational pressures. Radical innovations require significant effort and long lead-in times; they require the development of leadership capacity, a gap recognised within the sector (AWA, 2011).

We also live in a time of change within the Higher Education sector. Online learning purveyors, particularly Massive Open Online Course (MOOC) providers, have positioned themselves as offering world-class learning at little or no cost to the learner. Massive, open and online learning offers a response to increasing cost pressures on individual learners and a challenge to the traditional role and modes of learning that universities offer.

At the same time, the need to improve the way in which higher education is integrated with workplace skills and knowledge needs has been recognised in Australia as being key to achieving broader transformational ambitions for the national economy. Universities Australia, the Business Council of Australia, the Australian Chamber of Commerce and Industry, the Australian Industry Group and the Australian Collaborative Education Network have recently signed a letter of intent to strengthen university and business partnerships for the purpose of improving the integration of work-based and work-oriented learning into curricula (Universities Australia, 2014).

Whether MOOC providers such as Coursera (with its advertised over 6,700,000 registered learners spread over 622 courses from 108 university partners globally) are able to create new high-quality and financially sustainable models of education provision is still up for debate. The question of whether or not online-delivered courses or even entire degrees will provide high enough quality and sufficiently relevant skills and knowledge development to meet workforce needs has not yet even become a focus for debate.

So while we stand on the edge of significant changes to higher education, we argue that the transformational skills and knowledge agenda facing the water sector in Australia will not be delivered using massive online models of learning. Rather, based on what we know about effective leadership development (Taylor et al., 2012), we argue that the development of skills profiles for driving innovation and change in the water sector will itself require innovative and significantly more intensive face-to-face and immersive programs of learning. Our aim with this article is to critically review two example program models for innovative, professionally targeted higher education that have been implemented as a response to the transformational needs of the water sector here in Australia and in the UK.

Both programs are collaborative, involving multiple university and employer partners. The first model is a collaboratively delivered Masters Program run by the International WaterCentre (IWC) on behalf of a set of university partners to target Government, utility, NGO and consulting firm needs, while the second is a collaboratively delivered Engineering Doctorate Program focused on the needs of the UK water industry, called STREAM and run by a consortium of universities using leveraged Government and water industry funding.

How do these programs work? How do they employ collaboration and what benefits does this bring? What key success lessons can be learned from them for the broader transformational skills and knowledge agenda? How might these programs and the delivery and learning models they embody be progressed for the benefit of the Australian and other water sectors?
The concept of the T-shaped water professional underlies the design and delivery of a suite of Masters level water management programs offered by the IWC – the Masters of Integrated Water Management, or MIWM (which contains related Graduate Diploma and Graduate Certificate programs), and the Water Leadership Program (WLP) (see McIntosh and Taylor, 2013, and Figure 1). The overall ambition of IWC Masters level programs is to develop specialists able to operate across boundaries and in different situations rather than generalists with limited depth of knowledge. Figure 2 indicates graphically the difference between:

- **T-shaped skills profiles** – deep disciplinary or functional understanding and an ability to apply that understanding in different situations; an ability to ‘talk the language’ of other disciplines and functional areas;
- **Generalist skills profiles** – knowledge of many areas to a limited extent; able to recognise the need for change and to connect people, but not likely to be deep enough in any one area to identify how to innovate or to drive processes of innovation;
- **I-shaped or specialist skills profiles** – deep disciplinary or functional understanding; an ability to resolve complicated tasks and problems; and to deliver technically deep, high-quality outcomes.

Looking at skills and knowledge, there are three core groups of relevance as identified from work on emergent leadership in the water sector (Taylor et al., 2011, 2012):

- **Understanding** – the mix of additional skills and knowledge required to turn deep disciplinary or functional specialists into professionals able to collaborate across boundaries. In water, this knowledge would include natural sciences (e.g. hydrology, ecology), social sciences (e.g. sociology, psychology, governance, economics) and engineering (e.g. process treatment, hydraulics);
- **Organising** – the mix of management skills and knowledge that are essential for effective implementation of innovation, and for more general problem solving and team work within organisations. Examples include project management, systems thinking and stakeholder engagement;
- **Influencing** – the set of behaviours, strategies, tools and skills that are associated strongly with leadership as a process of influence. Examples include social networking, planning effective influence attempts and team leadership.

Within the T-shaped water professional model, these sets of skills and knowledge are positioned within a broader framework, which includes ethics, personal values and context. Context here is intended to show recognition that effective T-shaped professionals will have developed skills to appreciate the organisational and cultural contexts within which they work and to nuance their approaches correspondingly (Taylor et al., 2012).

The ambition of developing T-shaped water professionals is significant, perhaps more significant than in other professions, because of the sheer diversity of skills and knowledge required. Developing a broad, systemic appreciation of water management and how one’s own area of professional expertise is situated and relates to others involves a range of subjects from governance, law and policy through social impact assessment, stakeholder engagement and conflict management, to hydrology, water quality, ecology and engineering. In addition to these areas of substantive understanding there are skills in project management, teamwork and management, time management, networking and collaboration, as well as reflective personal values clarification and application.

The IWC T-shaped model targets the development of all three skills sets (understanding, organising and influencing), although not all within the same program, partly because the scope across all three is too significant to fit inside one program effectively. Instead, the programs of the IWC have been developed to deliver different components of the T-shaped water professional as outlined in Figure 2. The T-shaped water professional model targets the development of all three skills sets (understanding, organising and influencing), although not all within the same program, partly because the scope across all three is too significant to fit inside one program effectively. Instead, the programs of the IWC have been developed to deliver different components of the T-shaped water
professional skills and knowledge profile (see Table 1). Essentially, the Masters Program can be thought of as developing skills and knowledge to inform what to change (an outcome focus), and a little bit of implementation of innovation and change (a process focus), while the WLP focuses on developing skills and knowledge for implementation of innovation and change with a little on what to change.

To provide more detail, Table 2 shows the subjects that are covered within each program to deliver the components of the T-shaped skills profile.

### DOCTORAL-LEVEL LEARNING FOR INNOVATION AND CHANGE

The UK water and wastewater sector is composed of around 500 companies employing around 80,000 people. Of significant concern in the UK is the “persistent shortfall in the number of engineers required to achieve economic growth” (HoC STC, 2103) and the lack of ability of graduates to apply their engineering skills and knowledge development in the workplace (ICE, 2012). On top of this there are general and recognised needs to improve innovation performance and rates in the UK water sector (Cave, 2009) along with specific innovation needs surrounding tackling water scarcity, reducing carbon emissions and improving water quality (Energy and Utility Skills, 2013), creating a strong need for industry- and innovation-focused skills and knowledge development within engineering and related disciplines.

The UK Government’s Engineering and Physical Sciences Research Council (EPSRC – www.epsrc.ac.uk) has a long-standing funding mechanism that seeks to develop sector-focused engineering research, leadership and management skills and knowledge through the form of Engineering Doctorate (EngD) degrees run by universities. The mechanism, the Industrial Doctorate Centre (IDC), is a way of granting funding to consortia of universities to provide sector-specific research higher degrees in close collaboration with industry, so as to provide both a Government-leveraged means of industrial partners funding and directing research that will lead directly to innovation for them, and a means of developing the engineering research leaders of the future for the sector. IDCs have a research (knowledge production) function, a human capacity/skills and knowledge development function, and a broader function in creating links between industry and universities, which then facilitate the dissemination of ideas and catalyse innovation.

The EngD model of research education was established in 1992 as a way of combining excellence in engineering research with a broadening education to provide graduates (EngD holders) with the skills necessary to function effectively in the sector of their research. In 2009, 45 new IDCs were established by EPSRC with funding of £283m across a range of sectors (EPSRC, 2011). The water industry IDC is called STREAM (www.stream-idc.net) and is run by a consortium of Cranfield University, the University of Sheffield, Imperial College London, Newcastle University and the University of Exeter, along with an Industrial Steering Board composed of major utilities, consultants and contractors – Anglian Water, MWH, Thames Water, Balfour Beatty, WRC, United Utilities, Scottish Water and Severn Trent Water.

The STREAM IDC is based around the premise that developing the next generation of engineering leaders will require a subtle mixture of academic and industrial contributions. The IDC is essentially a program of industry-driven research that is delivered through the provision of part-industry, part-Government and part-university funded EngD studentships. Research projects funded through STREAM combine academic rigour with water sector priorities, typically ‘where there is a need to go back to fundamental scientific understanding and principles’ (STREAM Sponsor Survey, 2011), are collaboratively formulated by academics and industrial partners, and informed by associated research agendas.

The aim is to provide research students with a motivational training and research experience that will then launch their careers. Each cohort of STREAM EngD students undertakes a common induction semester comprising five advanced technical skills modules as well as a Group Design Project (GDP). This common program of technical skills and water sector context awareness prepares students for professional life in the water sector and ensures that they have enhanced competencies in areas such as engineering costing and risk evaluation before they join their sponsors to start their research projects. Beyond this, they are required to complete two additional Masters level technical skills modules over the course of their registration period, the choice of which is made in consultation with their academic and industrial supervisors and informed by the student’s ongoing technical skills or career development needs.

In addition to this advanced technical skills training and the research projects that constitute the core of the program, students on the induction semester commence a detailed transferable skills program. A number of field trips to water management schemes and treatment works providing first-hand experience of sector practices and challenges are also included.

A central tenet of the STREAM program is proactive development of researchers’ transferable skills. The STREAM Transferable Skills and Engineering Leadership (TSEL) syllabus was developed in close consultation with sector stakeholders and comprises five week-long modules covering: Research Skills, Business Environment, Personal Development, Communicating and Project Delivery.

The syllabus meets the expectations set out in the RCUK Joint Statement of Skills Training Requirements and is strongly aligned (95% concordance) with the transferable skills priorities advanced by the Engineering Council’s UK Standard for Professional Engineering Competence (EC, 2013).

The TSEL program has been designed to be delivered in a timely fashion to fit with research and career development...
### Table 2. Detail of the topics covered by the IWC MIWM and WLP against each T-shaped skills profile component (note, the list of topics is coarsely grained and not exhaustive).

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<th>T-shaped skills profile component</th>
<th>Masters of Integrated Water Management</th>
<th>Water Leadership Program</th>
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| **Understanding**                 | • Natural science (e.g. hydrology, water quality, aquatic ecosystem function and health, sustainability, climate science, urban climatology, dryland agriculture)  
• Social science (e.g. water governance, water policy, water law, environmental economics, development theory, sustainability, behaviour change, gender, participation and collaboration)  
• Applied science (e.g. social impact assessment, environmental impact assessment, IWRM, sustainable livelihoods, participatory rural appraisal, decision-making techniques, urban metabolism, life-cycle assessment, urban agriculture, conceptual modelling)  
• Engineering (e.g. water treatment, sustainability, low-cost water and sanitation systems, water supply system design, mass balance modelling, rainwater and stormwater harvesting, water-sensitive urban design, water/energy/nutrient recycling and recovery) | • Systems thinking  
• Methods to build leadership capacity over one’s career (e.g. mentoring, individual leadership development plans, feedback, challenging job assignments, etc) |
| **Organising**                    | • Project proposal development  
• Project management  
• Team working  
• Survey and interview design, execution and data management | • Self-leadership  
• Team development and leadership  
• Time management  
• Leadership development planning  
• Individual leadership development project planning and management. |
| **Influencing**                   | • Team leadership  
• Presentation skills  
• Conceptual modelling | • Water leadership models (relevant to the target audience) – e.g. project champion, enabling leader, team leader models  
• Models and theories from the organisational leadership literature (e.g. transformational, authentic, team leadership)  
• Social networking  
• Communication skills (e.g. active listening, giving and receiving feedback, etc)  
• Planning successful influence attempts, including the selection of appropriate influence tactics  
• Fostering innovation and creativity within teams  
• Individual leadership development project |
| **Collaboration**                | • Stakeholder engagement and participation  
• Conflict management  
• Team leadership  
• Team roles | • Distributed/shared leadership  
• Team leadership  
• Mentor-mentee relationships  
• Social networking  
• Communication skills |
| **Ethics and values**            | • Personal values clarification  
• Reflective practice  
• Equity  
• Ethical project management | • Personal values clarification  
• Communicating personal values to colleagues, acting in accordance with these values, and building credibility as a leader  
• Authentic, ethical and self-leadership |
needs. So, for example, early sessions cover topics such as research design and epistemologies, while later sessions focus on thesis preparation, proposal writing and career planning. Two of the five modules are delivered during the first year of registration, with one course per year over the following three years. The TSEL program also incorporates a one-to-one coaching program delivered by an external partner to provide bespoke tutoring for students in areas such as personal effectiveness and impact, leadership, communication skills and professional network development.

The STREAM IDC is similarly built on a model of collaborative delivery, albeit with some different dimensions to the collaboration. The TSEL component of the STREAM EngD is delivered by academics from across the five university partners, enabling the universities to play to their strengths of delivery and, consequently, enhancing the learning experience. This resonates with the collaborative, cross-institutional model of delivery utilised by IWC. The research projects themselves are industrially driven, and students receive academic and industrial supervision from the sponsoring company.

Normally students are embedded within their sponsoring company unless specific analytical equipment (e.g. from university laboratories) is required, when the student might be based at a university for a while. Being embedded within the sponsoring company enables significant learning to take place about how to apply research and theoretical knowledge into practice, and about how to drive research agendas by translating practical needs into engineering questions. These skills are vital in developing components for stimulating and driving innovation in the water sector more generally.

The cohort emphasis is also present in the STREAM EngD, which operates a single start date and entry point during the year, something not normally done for research higher degree students. This provides peer-to-peer learning and support opportunities, and participants will form networks that last far beyond the formal constraints of the program. These connections may then form part of broader innovation networks that benefit the sector as the EngD alumni progress through their careers.

Figure 3. Overview of the STREAM IDC EngD program.
Both IWC programs and the STREAM EngD emphasise the development of applied skills and knowledge by means of what might be termed immersion – learning from practice and experience by means of collaborating with external organisations or people. In the MIWM this is manifest through field trips and practicals embedded in modules, running some modules entirely immersed (e.g. learning about community development, water and livelihoods firsthand by staying in the homes of villagers in a rural Thailand setting) and by means of the final projects, which are often done on placement. In the WLP most of the learning (around 70%) takes place by implementing individual leadership development plans (ILDPs), including significant and challenging leadership projects at work. For the STREAM EngD the research projects are typically work embedded, and always industry driven.

SUCCESS FACTORS AND SOME THOUGHTS ON THE WAY AHEAD

The prospect of massive, open and online courses is looming, suggesting the potential for a revolution in higher education. The kind of innovation and change-oriented skills and knowledge development programs offered by the IWC and STREAM IDC provide something else: learning based on collaboration across traditional institutional boundaries; across disciplines, participant experiences and backgrounds; across the university-work divide; and in context. This form of learning is rich and popular. The IWC received over 450 applications for its MIWM program in 2014 and over 100 applicants expressed an interest in the STREAM EngD projects in 2013. Both programs are experiencing growth in numbers despite the economically challenging times, indicating demand for the professional learning and development involved. Central to this attractiveness is:

• Collaboration in delivery across universities and with employers;

• Use of innovative learning approaches (andragogies) that utilise a mix of asset-based, immersive and work-based learning;

• A focus on transferable and leadership skills.

Looking ahead for the Australian water sector, there are opportunities to develop models of research education similar to the EngD programs run by IDCs. Professional doctorates are available in most Australian universities and could offer a means of implementing a combined research and leadership education in the context of a broader range of disciplines than engineering alone.

Doing so, and improving engagement with industry to recruit staff onto programs like the MIWM and WLP, and to secure project opportunities, will enhance existing programs. There are also opportunities to develop more specialist collaboratively delivered Masters programs to focus on building postgraduate skills in particular areas of need for the water sector. These would complement existing offerings focused on leadership and transformational capacity such as the MIWM and WLP, and ensure the right mix of T-shaped and I-shaped professional skills and knowledge development to build the water sector of the future.

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REFERENCES


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