# CREATING A NEW GENERATION OF STORMWATER PRACTITIONERS

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**ABSTRACT**

As stormwater practitioners we are always looking into the future: how will climate change affect flood risk? How will we manage stormwater quality in our future cities with large urban growth? However, what will be skills and attributes needed for tomorrow's stormwater practitioners. How can we ensure that stormwater practitioners will be ready for the future and how they can be best placed to contribute to the growth and enhancement of our future cities?

The stormwater solutions of today and tomorrow require a multi-disciplinary approach due to changing objectives and goals of stormwater management. In order to meet these objectives we are increasingly working across different fields and disciplines such as hydrology and hydraulics, landscape design, water quality science, ecology and urban design. Collaboration and good communication are an essential part of the work we now do and will become increasingly important in the future.

In the future we will have access to an increasing amount of information, data and tools to be able to model and compute information to a level never seen before. The key skill will be how to analyse the data for meaningful outputs. The future practitioner will need to embrace change. Changes in objectives, how we work, where we work, the people we work with and how we communicate.

Numerous studies and articles have been presented by organisations and professional societies concerning challenges for the future of engineering and technical professionals. The purpose of this paper is to present some of the main key challenges that are facing the future stormwater practitioner and discussing the skills and environment required for the future. The four key challenges discussed in this paper include changing stormwater goals, data and new technology, population and diversity and change. The three key areas discussed of how we can respond to the future challenges include; learning and continuing education, networking and collaboration and adaptability and change.

**KEYWORDS**

**Stormwater, Future ready, Education, Training, professional development, mentoring.**

**PRESENTER PROFILE**

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# 1 INTRODUCTION

Stormwater practitioners and engineers of today are operating in an environment that is changing faster than ever before. The stormwater profession has seen a shift from design of pipelines and culverts for stormwater conveyance to an inter-disciplinary approach, which considers stormwater management in parallel with broader knowledge and skills such as sustainability, water as a resource, community involvement, cultural values, ecology and urban design.

The future stormwater professional will be required to use new tools and apply ever-increasing knowledge in expanding disciplines, all while considering societal repercussions and constraints within a complex landscape of old and new ideas (Clough 2004).

Numerous studies and articles have been presented by organisations and professional societies concerning the future of engineering and professionals and discussing the workforce and skills required for the future. The purpose of this paper is to present some of the key challenges for the future stormwater industry and discuss characteristics and skills that are required for the future stormwater practitioner with some practical suggestions of how to meet these challenges.

# 2 THE FUTURE CHALLENGES

## 2.1 IDENTIFICATION OF KEY CHALLENGES

From the literature research I have identified four key challenges that are relevant to the future stormwater industry:

1. Changing stormwater goals
2. Data and new technology
3. Population and diversity
4. Change

Each of these challenges are discussed in further detail below.

## 2.2 CHANGING STORMWATER GOALS

In New Zealand and internationally there is a focus on transitioning to more sustainable urban water management. This shift has been a response to challenges associated with environmental degradation, rapidly growing urban populations and impacts from climate change. Urban stormwater infrastructure traditionally promoted conveyance. Stormwater management goals of today are evolving beyond conveyance and flood control to an inter-disciplinary approach, which considers stormwater management in parallel with broader knowledge and skills such as sustainability, water as a resource, community stakeholder involvement, cultural values, ecology and urban design.

The Water Environment Federation (Wef) in 2015 presented a vision for the future of stormwater "In the future, all stormwater will be considered a resource and managed through an optimized mix of affordable and sustainable green, gray and natural infrastructure. Pollutant source control and management of runoff volume will be pursued aggressively as a complement to traditional stormwater controls. Management techniques will improve continually through new science, experiences, technological innovations, and in response to changing regulations. Stormwater management will be

part of doing business and part of community resilience and quality of life. The community will value and understand the many benefits of stormwater infrastructure." In the future the goals and objectives of stormwater could evolve further and broaden the base of criteria that we need to meet.

The literature reviewed includes many studies around the changes in the engineering industry in general, and concerns around both engineering education and practice which is relevant to all stormwater practitioners. New paradigms for engineering education are demanded including the need to accommodate a far more holistic approach to addressing social needs and priorities, linking social, economic, environmental, legal and political considerations with technological design and innovation (Duderstadt, 2008). Engineering must be grounded in the fundamental principles of science and mathematics as a foundation to support the development of new knowledge and creation of safe, reliable, and innovative technologies that advance society (National Academy of Engineering, 2004).

## 2.3 DATA AND NEW TECHNOLOGY

Technology and availability of data is drastically changing the decision making process. With the increasing access to overwhelming amounts of data, the future will require those that can have the skills to meaningfully analyse and assess this data. In a recent presentation by Jim Quinn, Chief of Strategy for Auckland Council, he gave a vision of a Smart City for Auckland. His definition of a Smart City was not only one that was digitally connected, but one that could deliver valuable things that work for the city. He spoke about how the city can be connected by meaningfully using the "mountain of data" that will be available in the future.

Skills the workforce of the future will need is discussed widely through media and literature. A recent Huffington Post article presented the top 10 skills the future workforce will need and included "They will be data analysts – we swim in seas of data, and like most oceans, they will be dark waters that will require some navigation to sail through to find the dry land of useful information". The key skills will be how to effectively use the data to be relevant. The article however goes further to identify "the ability to tell a good story will be valued over spreadsheets, graphs and data points" stressing the ability to present the data in a narrative way will become an important skill.

The World Economic Forum's Future of Jobs report (January 2016), seeks to understand the current and future impact of key disruptions on employment levels, skill sets and recruitment patterns in different industries and countries. The report presents a Fourth Industrial Revolution where "Smart Systems" will help tackle problems ranging from supply chain management to climate change. The job types that stood out in their study included data analysts, which companies expect will help them make sense and derive insights from the torrent of data generated by technological disruptions.

Across nearly all industries, the impact of technological and other changes is shortening the shelf life of employees' existing skill sets.

## 2.4 POPULATION AND DIVERSITY

Like most of the developed world, New Zealand has an ageing population. By 2036, it is projected that around 1 in 4.5 New Zealanders will be aged 65 plus or an additional 547,000 over 65's, up from a total of 711,200 in 2016 or 77% Increase (Statistics NZ).

In the coming years the engineering industry in New Zealand will see the retirement of an increasing amount of experienced personnel and potentially some highly experienced expertise and knowledge could be lost to the industry.

As an example of the loss of experience is the skills of stonemasons. Historic structures stand as testaments to the skills of the tradespeople who built them. The skills required to become a stonemason were not 'book learned' when the great cathedrals of Europe were built. In our current day however, the techniques they used during construction are often difficult to identify and understand as the skills of a stonemason have not been progressively passed down. Contemporary architecture requires different skills, materials and methods, and in many cases old ways of building have been completely replaced (Christian, 2002).

The industry needs to ensure that while we are looking to the future, historical knowledge and skills are not lost with a generational change. My Grandfather worked for a local council for 40 years, and in his retirement he was frequently contacted by council to ask about locations of existing infrastructure due to in-complete asset records. The industry needs a commitment to passing on historical knowledge and skills to the younger generations. Experienced practitioners need to pass on their practical knowledge and expose younger practitioners to practical experience, such as knowing what a 1200mm diameter pipeline looks like? What does a 1m3/s flow look like?

Urban growth in our main centres is, and will continue to be, a challenge for the future. In Auckland the population of 1.5million is expected to increase to 2.5million people over 30 years. In a typical week in Auckland there are:825 new residents, 472 jobs created, 278 new dwellings required, 52 additional students (Auckland Council Website, 2016). Higher density living and a compact city is Auckland's main priority for future development. New buildings are to be focused around urban centres by higher density zoning.

Diversity in the work place and the diversity of our cities and towns is also increasing including gender, ethnic and age diversity. This diverse workplace both now and future will offer a wider range of skills, experiences and views that are all valuable in providing and managing infrastructure for today's and tomorrow's diverse society. Diversity in the workplace and project teams provides significant benefits by delivering solutions that ensures sustainability of the profession and ability to understand the public it serves. Understanding and promoting diversity will be increasingly important for those who are managing and appointing staff and the recognition of the benefits of diverse teams and workplaces.

The Institution for Professional Engineers New Zealand (IPENZ) reports that barely 13 percent of New Zealand's engineers are women. Less than six percent are Maori and less than 2 and half percent are Pasifika (Clarke, 2016). If our industry is to reflect the society we work in, then clearly there is some room for improvement.

The challenge will be how to ensure existing knowledge and skills are not lost between generations and how to create effective functional teams with a diverse workforce with varying skills, experience, knowledge, culture and language among others.

## 2.5 CHANGE

We live in a time of great change, and an increasingly global society, driven by the exponential growth of new knowledge and knitted together by rapidly evolving information and communication technologies (Duderstadt, 2008).

The future of work will soon come "the Survival of the most adaptable", says Paul Mason, emerging technologies director for Innovate UK (Seager, 2016). As new technologies fundamentally change the way we work, the jobs that remain will be multifaceted and changeable(Seager 2016).

Many of our workplaces are currently operating at a constant state of change with re-structures, changes in strategy and directions with pressure for increasing efficiency and cost control. For the future practitioner organisational change is likely to be constant.

In today's world of change, most graduates will find themselves frequently changing not only jobs, but entire careers several times during their lives. Future predictions forsee working to be highly adaptable and people may juggle three or more different roles at a time (Seager, 2016). In order to keep pace of change people will need to consistently retrain to keep up-to-date with the latest technological advances, and as some jobs are increasingly automated and made redundant.

Not only will technology change, the social-political-economic world in which practitioners work will change continuously. In this context it will not be this or that particular knowledge that practitioners will need but rather the ability to learn new things quickly and ability to apply knowledge to new problems and new contexts (National Academy of Engineering, 2004).

The challenge for the profession is not only how we can keep the workforce up to date and retain the current and future body of knowledge. Further, how do we maintain quality assurance of design processes and ensure risks and compliance are adequately managed in this changing environment.

# 3 HOW DO WE RESPOND TO FUTURE CHALLENGES NOW?

## 3.1 BACKGROUND

Literature is extensively available discussing the future challenges of engineering and the stormwater profession. However the literature is somewhat limited on how we can respond to these future challenges and ensure the industry and our current graduates are preparing for the future. The following section is based on industry research available and concludes with recommendations to prepare the future stormwater practitioner.

The key areas of how we can respond to the future challenges include:

1. Learning and Continuing Education
2. Networking and Collaboration
3. Adaptability and Change

## 3.2 LEARNING AND CONTINUING EDUCATION

Underlying technology and science for solutions is rapidly evolving. While the basic theories of hydrology and hydraulics remain the same, stormwater management techniques will improve continually. As technological innovation rapidly increases practitioners will be more challenged to shift from traditional problem solving and design skills to more innovative solutions embedded in an array of social, environmental, cultural and ethical issues (Duderstadt, 2008).

We must not only retain, but strengthen, our solid expertise in technical fundamentals and practical knowledge. With the advancement of computer modelling and design we must still retain the ability to make reasoned judgements based on engineering knowledge, experience and common sense. Just because we have a computer model that gives us an answer in 3 decimal places, for example, this does not mean that it is correct or reasonable.

Overall, social skills – such as persuasion, emotional intelligence, ability to communicate effectively and teaching others – will be in higher demand across industries that narrow technical skills. In essence technical skills will need to be supplemented with strong social and collaboration skills (WeF, 2016).

Many of the challenges regarding water that communities will face in the future, will be to some extent, unique, and are unlikely to be resolved in a one-size-fits-all solution. Tackling the "messy" problems of the future will require learning-by-doing and open information sharing for collective knowledge building (Maas et. al, 2012).

Continuous learning not only requires commitment from individuals, but requires commitments from industry to training and mentoring and passing on knowledge.

Some organisations offer exchange type programmes where 2 or 3 companies provide exchanges between graduates across different organisations such as a contractor, consultant and local/central government. This is an excellent way to expose graduates to the many organisations that are within the industry and gather different skills and experiences from the work.

Mentoring can enhance professional and personal growth and development. The origin of the word "Mentor" was inspired by a character in Homer's 'Odyssey'. When Odysseus went to fight in the Trojan War he entrusted the care of his household to 'Mentor'. Mentor served specifically as a teacher to Odysseus's son, Telemachus, to prepare him to become the future king or Ithaca. In time the word 'Mentor' became synonymous with 'trusted advisor, friend, teacher and wise person'. (Opus Mentor workbook). Today mentoring has taken on a number of definitions but all essentially carry the same meaning. It's about a relationship in which someone with identified abilities or competencies enables another person to develop their own abilities and talents. Mentoring is a relationship that constantly grows and changes course.

Mentoring encourages and supports the development of professional knowledge, competence and high standards of performance. It accelerates learning and development, makes people feel valued, helps people tap into their own potential and taps into talent.

Professional organisations play an important role in industry training. Training opportunities are available through organisations such as IPENZ, WaterNZ, IPWEA and others. Local Bodies also have a role to play in industry training, particularly when introducing new standards and rules.

## 3.3 NETWORKING AND COLLABORATION

A paper titled Building a Professional Capacity for a Water Sensitive Future in Ontario (Maas et al,2012) presented Communities of Practice (CoP) and Social Networks as main drivers to achieve a water sensitive future. CoP is defined as a group of people who share an interest, craft or profession. It is through the process of sharing information and experiences within the group that the members learn from each other. In the New Zealand stormwater industry there are several examples of communities of practice,

including the Water New Zealand Stormwater Group, who are active in informing policy and arranging knowledge sharing events. In my organisation we also have global networks where special interest groups can share knowledge and solve issues utilising digital collaboration and networking platforms. In a future that will be under constant change networking will play a crucial role in learning, development and innovation.

Government organisations and private organisations are increasingly strained with reduced budgets and a desire to operate efficiently. Collaboration with local governments, business, academia and professional associations will enable research and project outcomes to be shared and enable skills and knowledge to be shared.

As always, good practitioners will require good communication. In the future however the parties that practitioners tie together will increasingly involve interdisciplinary teams, globally diverse team members, public officials and a global customer base. Modern advances in technology will also necessitate the effective use of virtual communication skills (National Academy of Engineering, 2004).

In the consulting world the way in which we work is changing. We are more and more being involved in cross consultant project teams, joint ventures, alliances, secondments and design and build type arrangements. In my personal experience I have had invaluable experiences from working in contractor / consultant project teams and design teams with other consultants, particularly when individuals from different organisations are open and willing to learn from each other.

## 3.4 ADAPTABILITY AND CHANGE

How do we ensure the future practitioners will be adaptable and open to change?

Change is expected to be a constant in the future including changes in technology, demographics, business models, socio-economics and the environment will impact how we work. For organisations, not anticipating and addressing such issues in a timely manner may come at an enormous economic and social cost for businesses, individuals and economies and societies as a whole (World Economic Forum, 2016). Organisations need future workforce strategies to prepare for these shifts.

**Continuous learning** and re-skilling as covered above enables practitioners to learn new skills and manage and adapt to changes in the way we work and the skills that are required. As stated above this will require commitment from individuals, organisations and industry to training and mentoring and passing on knowledge.

**Succession planning** also plays an important role in planning for change, particularly as the sector will see a wave of retirements with the aging demographic in New Zealand and internationally. Succession planning enables organisations to be prepared for changes in personnel, particularly in preparing the next general for leadership roles. Succession planning should account not just for top leadership positions or the most specialised jobs, but for all roles critical to the organisation's performance. A McKinsey report recognises that in the public sector, these critical roles are not always so clear cut. They might include not only leaders of large departments but also individuals managing significant reputation risks or overseeing important change initiatives (Kerlin et al, 2008).

**Exchanges and transfers** offers graduates and others opportunities to move around an organisation or industry and requires the individual to embrace changing circumstances of their everyday work. This could take the form of a transfer between departments

within a company, a secondment to another organisations or a transfer to an overseas office. An example is having a graduate programme that facilitates experiences within different teams or specialisations.

**Creating a culture for innovation -** an environment that encourages creative ideas and innovation on an ongoing basis. There is a large amount of literature of how to create a culture of innovation. Sustained innovation comes from developing a collective sense of purpose; from unleashing the creativity of people throughout your organisation and from teaching them how to recognize unconventional opportunities (Karlsberg & Adler). Common themes in how to create a culture of innovation include; starting at the top with leadership promoting innovation, having open communication between management and employees to set the stage for an atmosphere of trust, and tolerating a certain degree of failure as a necessary part of growth. Allow some unstructured time. Give people the time to experiment with new technologies, explore new ways of doing things or meet with others informally to discuss newly minted ideas (Martinuzzi, 2014). Innovation is a risk. Employees won't take risks unless they understand goals clearly, have a clear but flexible framework in which to operate and understand that failures are recognized as simply steps in the learning process (Karlsberg & Adler).

# 4 CONCLUSION

So what does the future stormwater practitioner look like: he/she will be learning continuously throughout their career, will work alongside others with a range of skills and expertise, and will engage and communicate with many different groups and stakeholders within the global society. The practitioner will play an integral role in harnessing new technology, discovering new ways of doing things and enabling the effective use data in order to solve the complex issues to meet wide ranging goals and objectives.

While this paper is not intended to provide a comprehensive suite of detailed solutions, it brings to the fore many of the challenges and opportunities in the growth of the profession.

**ACKNOWLEDGEMENTS**

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