VIRTUAL REALITY FOR GREEN URBAN WATER INFRASTRUCTURE PLANNING

Project Background

Rapid urbanisation has been challenging the way we manage cities, in particular our urban water systems. In urban water management, Water Sensitive Urban Design stormwater systems (WSUD) are low-energy, space-efficient, scalable green technologies that have been widely adopted to deliver environmental protection and other multiple benefits, such as alternative water supply, greening of urban space and improved urban amenity[1, 2].

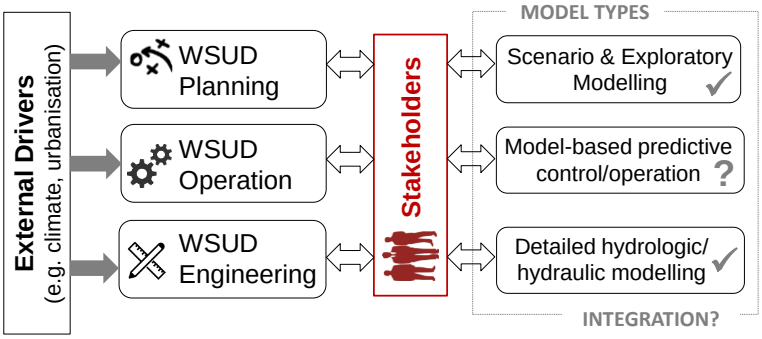

Fig 1. Conceptual Framework, role of models and stakeholders in the WSUD planning process

Effective planning for WSUD is, however, not a straightforward engineering design problem, but requires understanding of the relationships with urban development. It is also a balancing act between many stakeholders with conflicting needs and priorities. With expanding urban development over the next 50 years, we are at the brink of major urban change. There is an urgent need for efficient and sustainable stormwater management now as the costs of retrofitting cities later would be monumental[3]

Despite advancements in WSUD over the last 20 years and rapid uptake of in practice (with over 10,000 systems implemented across Melbourne alone), significant knowledge gaps are still prevalent about the dynamics of WSUD management (from initial planning stages all the way through to operation of implemented systems – Fig. 1). There are serious concerns about the long-term efficiency of many existing WSUD assets due to poor design, construction and maintenance decisions[4-6]. Furthermore, existing WSUD models (see Fig. 1) that are typically used to support planning and management processes[7-9] are unable to fully consider its complex interactions with urban development and socio-economics. Knowledge transfer to WSUD practice is stagnating. If nothing is done to harness our current WSUD approaches to better consider these complex dynamics, the economic and logistic cost of managing existing WSUD assets will soon outweigh their perceived benefits.

New techniques in integrated modelling for sustainable urban water management are constantly being experimented with and the incorporation of social dynamics into models is becoming more common[8]. Additionally, the use of computer games and virtual reality as platforms for understanding human decision-making has gained increasing attention in the planning sphere[10-12]. With a plethora of visual styles and simulation games emerging from the gaming industry (see Fig. 2 for examples), there is a huge opportunity to explore the use of these in advancing the modelling and interdisciplinary science of WSUD management.

Fig 2. Examples of Gamifying the City (left - SimCity4, source: EA Games ; centre - Anno2070, source: Ubisoft, right: LowPoly City Model for Unity3d Game Engine, source: VenCreations)

Aims & Objectives

This project, known as VR Water for short, aims to ***develop a new understanding of the complex planning-technical-social dynamics of Water Sensitive Urban Design***. It will achieve this through advancing existing WSUD modelling science and utilising state-of-the-art immersive virtual reality and gaming technology for eliciting and analysing complex planning and decision-making processes of key actors in WSUD planning and management.

The two key aspects of this project include:

- Developing and testing a novel dynamics model of long-term WSUD planning, which also incorporates tacit knowledge from practitioners across Australia
- Transforming this complex integrated model into a computer game, which can yield insights into collaborative decision-making when played by groups of stakeholders

Approach

This highly interdisciplinary project involves a wide range of researchers with different expertise including engineers, architects, social scientists and game designers. Qualitative research methods including interviews and workshops will be combined with integrated and exploratory modelling science. An interactive gaming environment will be developed using cutting edge virtual reality technologies that are rapidly growing in popularity including some shown in Fig. 3.

We will build upon an existing planning-support tool, the UrbanBEATS model (www.urbanbeatsmodel.com), which is rapidly gaining attention in the urban water industry as a powerful and flexible tool for exploring the planning of WSUD in urban precincts. Using the industry standard Unity3D game engine (www.unity3d.com), we will create a highly visual and interactive gaming experience that is based heavily on tacit knowledge and experience informed by our industry stakeholders and our exploratory model.

Fig 3. Emerging immersive technologies including CAVE2 at Monash University (top), Samsung GearVR headset(bottom left) and Mixed Reality with Microsoft HoloLens (bottom right)

Research Outcomes

This research will empower stakeholders to more effectively plan WSUD strategies in existing and new cities at the most appropriate and cost-effective points in time. Key outcomes include:

- new insights into the long-term dynamics of WSUD and advances in current WSUD modelling science
- an understanding of the complex planning-technical-social interactions of WSUD will lead to more resilient integrated stormwater management solutions and policies and;
- serious computer gaming will yield insights on stakeholder decision-making, provides a platform for collaborative planning and WSUD knowledge transfer and training

Contact Details

Peter Marcus Bach
Project Lead – ARC DECRA Fellow
Monash Infrastructure Research Institute
Monash University, Clayton 3800 VIC
e. peter.bach@monash.edu
m. 04 3217 5283

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