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Water Experts' Perception of Risk for New and Unfamiliar Water Projects

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Abstract: In the context of a changing urban environment and increasing demand due to population growth, alternative water sources must be explored in order to create future water security. Risk assessments play a pivotal role in the take-up of new and unfamiliar water projects, acting as a decision-making tool for business cases. Perceptions of risk ultimately drive risk assessment processes, therefore providing insight into understanding projects that proceed and those that do not. Yet there is limited information on the risk perceptions water professionals have of new and unfamiliar water projects. In this study, 77 water professionals were surveyed from across the Melbourne metropolitan water industry to examine risk perceptions over a range of different, unfamiliar water projects. The qualitative data was thematically analysed, resulting in a number of risk perception factors for each hypothetical project. Risk factors that recurred most frequently are those that relate to community backlash and to the reputation of the organisation. These social risk perceptions occurred more frequently than other more technical risks, such as operational risks and process-related risks. These results were at odds with the existing literature assessing risk perceptions of business-as-usual projects, which presented cost as the key risk attribute. This study sheds light on the perceived nature of new and unfamiliar processes in the water sector, providing an understanding that public perceptions do matter to experts involved in water infrastructure decision-making.

Keywords: risk perception; water utilities; water experts; recycled water; community; fluoride

1. Introduction

The varied nature of risk, and how perceptions differ between stakeholders, has not been fully considered in the water sector, especially from a cultural and psychological perspective [1]. In particular, there is a lack of research regarding water utilities' perceived risks associated with new and unfamiliar projects. Perceptions of risk influence the decisions made about water infrastructure projects, and are, hence, an important consideration. Climate change, along with population growth and other socio-economic factors, is impacting the availability of freshwater resources [2]. This has implications for the need to consider water supply projects that are alternative to the traditional sources of supply. Hence, there is a need to understand utilities' risk perceptions of alternative water projects, so as to best design and facilitate their project implementation if, and when, necessary.

Placing this in the context of the special issue, public infrastructure, including water and sewage services, is essential to the efficient functioning of urban areas. Infrastructure provides the resources necessary to support urban economies, environments, and societies. Decisions surrounding the design and maintenance of public infrastructure (including water supply) involve the formal assessment of risk by experts (the word 'expert' is used in this paper to refer to a person with specialised knowledge

in a particular area—in particular, those who have mastered certain skills they utilise in their careers. It is used interchangeably with 'professional' within this study). The importance of understanding public perception of risk associated with urban infrastructure projects has gained prominence over the past two decades. This is in part due to public and political opposition to project proposals, which ultimately led to the abandonment of plans in some cases. This includes, but is not limited to, proposed potable recycled water systems in Toowoomba, Australia [3] and San Diego, USA in the 1990s [4].

The aim of this paper is to explore the risks that water utility experts perceive as being associated with new and innovative projects, and how risk perception differs across projects. This aim is addressed through an empirical study of 77 experts working across four water utilities in Melbourne, Australia. An open-ended, qualitative approach is taken to identifying risk perceptions, leaving experts to highlight their own risk factors, rather than presenting predefined ones. This allows for a more exploratory approach to the question of risk perceptions. The research also differs from others through highlighting risk factors related to "new" or "unfamiliar" projects, (projects that have previously never been undertaken by the water authorities) and therefore explains risk attitudes to innovative approaches to water. The risks that were seen by water professionals as highest included community backlash and reputation to the organisation. These findings were unexpected considering the non-technical nature of the risks, highlighting a shift of the focus from the traditional public health aspect of water.

The paper begins by discussing key literature in the field of risk perception and water supply. The study's research method is then detailed, before the presentation and discussion of results.

2. Risk Assessment and Risk Perceptions

Risk plays an important role when considering the take-up of new methods and processes in the water industry. Risk assessment of a project often guides business cases and acts as a major decision-making tool for proposed schemes. As such, understanding perceptions of risk can guide us in understanding innovative or unfamiliar projects that proceed, compared to those that do not.

The epistemology of risk exhibits the tension between risk theories—in particular, the underlying element of whether risk is seen as a subjective or objective concept [5]. This refers to the notion of whether a "real" or "true" risk actually exists. Perceptions of risk, rather than whether a risk is seen as true or not, is what ultimately drives decision-making, and, therefore, we do not argue for or against the real, objective risk but instead highlight personal professional notions of perceived risk.

2.1. Risk Perceptions, and How These Differ between Laypeople and Experts

Extensive research has been undertaken in the space of risk perceptions and how they differ between laypeople and experts. Predominantly undertaken in the United States, this field of study expanded in the 1980s and continues to provide insight into understanding public perception, particularly in an environment in which participatory democracy is encouraged. Slovic and Fischoff are key proponents in this field, highlighting the importance of understanding individual psychological factors in the construction of perception [6,7]. They argue that the individual's psychological affiliation to a risk, based on personal experience, provides a key explanatory factor in their perception of the risk. Fundamental attributes, such as the "dread factor" (the sense of dread associated with the risk), or the "newness" of the risk (how familiar the risk is) are examples of explanatory elements of understanding risk perceptions [6].

When comparing public risk perceptions to those of experts, Slovic and Fischoff's study showed that of the laypeople surveyed, they generally ranked nuclear energy high in risk, because of the sense of dread associated with the effects of a negative radioactive fallout [8]. In comparison, they ranked the risk of driving a car as very low, despite figures showing the chance of being involved in a car accident is far higher than a nuclear one [6]. Experts instead had ranked driving a car as significantly higher risk than nuclear power, which the authors suggest is based on an objective understanding of the safety of nuclear energy, and, thus, the dread or familiarity factor is dissimilar to the layperson [6].

This evident difference in risk perceptions between lay people and experts becomes a challenge when the question of public policy, or deciding on public spending, enters the discussion. Prior to the 1960s, expert assessments were generally accepted by the public, with far less scrutiny than today [9]. As such, public consultations and public opinion polling did not carry as much relevance as they do now. Schon argues that the loss of faith in professional judgement began to occur between 1963 and 1981, much due to the unintended side effects of new technologies, and also conflicting recommendations within a professional field itself [10]. The consistent debunking of professional advice and theories also proved to be a large factor in the increasing distrust of professional experts [9,10]. Slovic also contends that this increase in distrust has also then flowed to distrust of risk assessments undertaken by these experts [7].

Similarly, a study by Schlosberg et al. [11] in Melbourne, Australia has shown a clear distinction between climate change discourses of government authorities and the public. In considering climate change adaptation, local government bodies used words like risk, water, control, event, and management [11]. In contrast, they found that community groups used language that focused more on the impacts of basic needs, such as "food", "community", "people", "energy", "water", and "local" [11]. The authors highlight the discordant nature of risk discourses between laypeople and experts, and posit that this may be due to lack of public engagement, while Guy and Kashima [12] theorise that it is a knowledge-based distinction.

2.2. Risk Perceptions Related to Water Projects

The supply of water to the public is an important service, given the dependence humans have on water for their survival, health, and economic prosperity. Additionally, the very nature of water's close link to the politically contentious issue of climate change creates an increase in public interest. The topic of water is not immune to the effects of a discourse on climate change, and, in particular, what adaptation measures should be undertaken—an area that is highly contested [13].

Climate change adaptation measures, including those necessary in the water sector, are highly politicised. This can be attributed to clear differences on the issue existing along political party lines in Australia [14]. Unsurprisingly, as an issue of public interest, media reports on water projects serve to sway opinion on climate change issues, as shown in a study on desalination delivery and public interest by Ettehad et al. [15].

Public sentiment—or backlash—can halt or stop projects altogether, and thus plays a key role in the project management process. Hurlimann and Dolnicar analysed the reasons why an indirect potable recycled water system proposed in 2006 for Toowoomba, Australia failed [3]. A plebiscite was held, and over 60% of the community voted against the scheme. The authors found that the failure of the plan was not just associated with community opposition, but also due to political involvement, the timing of the plebiscite, vested interests, and information manipulation. Public opposition also had a role to play in other potable reuse schemes including San Diego in the USA in the 1990s [4], and for desalination plant proposals, including Sydney in the 2000s [16]. Some authors [17] have attributed a decide, announce, defend (DAD) approach to the demise of these schemes [18].

Creating an alignment between public and expert risk perceptions is, thus, vital in a participatory democracy [7]. Yet there has been limited research conducted in this field, particularly applied to water infrastructure projects. Much literature focuses on public perceptions of risk in water [19–23]; however, there have been limited studies on expert risk perceptions for innovative, or new, water practices. The few studies that do investigate expert risk perceptions in water do not consider the Australian context [24,25]. Notable exceptions include studies by West et al. and Dobbie et al. on expert risk assessments in Australia [26,27]. In the study by West et al., the top three risk factors identified for the long-term viability of reuse schemes were unanticipated operational costs of the recycled water treatment plant, customer complaints, and regulatory requirements and approvals. Public health was seen as comparatively low risk (due to a low consequence score given by practitioners); hence, they call for a broadening of the traditionally considered risks in scheme assessments. The study by Dobbie et al. also considered expert risk perceptions of water projects, but focused on a varied number

of projects, including stormwater harvesting, and also potable reuse [27]. The highest perceived risk for most of the alternative water projects was that of perceived cost, which Dobbie et al. put down to the traditional asset management that takes place within water authorities [27].

In another study by West et al. [28], 88 water experts across Australia were surveyed regarding the viability of residential recycled water systems. They found that a major risk to the long-term viability of recycled water systems was the inability to provide an incontestable business case. This, in turn, was found to be influenced by other risks including political, regulatory, organisational, financial, and community risk perception. Other studies in risk perceptions in the water industry in Australia mainly focus on the technical nature of risk assessments, determining their effectiveness. Very little research has been undertaken on understanding the psychological and cultural aspects of risk perception in the water industry [1].

3. Materials and Methods

3.1. Study Context

The study took place in Melbourne, Australia looking at three metropolitan water retailers (Yarra Valley Water, South East Water, and City West Water), and one bulk water provider (Melbourne Water, Melbourne, Australia). Melbourne's water is mainly supplied by dams in Melbourne's east. A drought in the 2000s brought water to the forefront of public discussion, as water restrictions were imposed and a controversial desalination plant proposed, as well as the installation of equally controversial infrastructure for inter-basin transfers. The drought has since broken, but there are still dire predictions based on increasing demand due to population growth, which are likely to place a strain on water resources in the future [29].

3.2. Overview of Risk Assessment Processes in the Water Industry in Melbourne

All four water authorities who participated in this research (Yarra Valley Water, City West Water, South East Water, and Melbourne Water) closely follow the standard approaches highlighted in AS/NZS ISO31000:2009 Risk Management: Principles and Guidelines [30]. Risk assessments are used within business cases, and as a tool to decide on a course of action, for example, within an options assessment. They can be used throughout a whole project; however, whether to fund a project is ordinarily decided upon at the concept phase.

Generally, the project delivery process runs from a concept phase, which could include an options assessment, through to preliminary design, functional design, detailed design, construction, and commissioning. The options assessment incorporates risk assessments as part of the early decision-making process, either in the format of a risk rating or statement, or in the form of a Cost–Benefit Analysis. Both of these can be argued to be heavily reliant on the risk assessor's perception and judgement. The projects that are approved based on these risk assessments are then allocated funding in future Water Plans. Fund allocations are determined by the water authority themselves, unless it is a large project of state political interest, which may have heavy political input. Other assessments, such as environmental impact statements, are ordinarily conducted at a later stage of the project, such as the Preliminary or Functional Design stage, and then may have less impact on whether the project is placed in the water plan for the future.

Yarra Valley Water, Melbourne Water, City West Water, and South East Water all have similar risk assessment approaches, with slight variations in risk appetites. Risks are categorised in the organisation's internal risk framework. These include elements such as safety risk, reputational risk, financial risk, customer risk, etc. In all three water authorities, they ensure that all of these risks and their examples of consequences are highlighted in a negative consequence table. Based on the ISO31000 standards, they all consider the consequence of a particular risk and, also, the likelihood of the risk occurring [30]. A score is given to each of these (the consequence and the likelihood separately) based on an assessment undertaken by the project manager.

Risk perceptions play a large role in driving forward new water projects at the project management level [31]. A risk assessor (the water professional) undertakes a risk assessment to determine the viability of selecting a certain course of action, such as in an options analysis. Their own risk assessments play a large role in understanding the projects that proceed, hence the importance of considering the implications of the risk perceptions observed in this study.

3.3. Data Collection

Surveys were undertaken at four metropolitan Melbourne water authorities (Melbourne Water, Yarra Valley Water, City West Water, and South East Water) between April and July 2017. Participants were recruited from within each of the water authorities through a single contact; in most cases, through the risk manager within the organisation. A total of 77 participants were recruited and completed the survey (34 from Yarra Valley Water, 16 from Melbourne Water, 14 from City West Water, and 13 from South East Water). The requirement for participation was to be a water professional who has previously undertaken a risk assessment on a water project. Participants from varied positions and employment levels were recruited, ranging from team members through to General Managers. Participants were of varied ages and gender. This ensured that a broad cross section of the workforce was surveyed.

Paper-based surveys were administered in sessions at each of the Water Authorities' main office. A pilot survey was undertaken prior to the main study commencing. The lead researcher was present to answer any questions and clarify any ambiguities.

As part of the surveys, participants were presented with three different projects: a recycled water treatment plant project (see Box 1), a new water treatment process (Box 2), and a project involving the removal of fluoride in the potable water supply (Box 3). Each project was entirely fictitious. Respondents were asked to derive a numerical risk assessment score for each project, and were then asked the following qualitative question: "What do you consider are the main risks arising from this project?" They were then asked a series of follow-up questions regarding risks associated with the proposed project, and risk perceptions in general. Demographic data was also collected.

The results were analysed to address this paper's aims, focusing on the answers to the open-ended risk perception question detailed above.

Box 1. Project 1—Using Recycled Water as Potable.

A Class A Recycled Water Treatment Plant in the historic area of Gumbark will be upgraded to allow for potable-quality water. This water will then be inserted directly into the potable supply, and mixed in with the existing potable water and delivered to residents within the area via the existing two-pipe system. Notifications and information sessions will be given to all residents prior to implementing the change. The total cost of the projects is expected to be $3.5million, delivering potable re-use water to approximately 1200 residential properties and businesses.

Box 2. Project 2—Using Radiation in Treatment of Drinking Water.

Research has been released, following extensive studies at various Water Collaborative Research Centres, highlighting a more effective way of treating drinking water that doesn't affect its taste and colour. The treatment process involves the use of high levels of radiation to exterminate any unsafe elements from drinking water. It results in a one-step process of treating water, and, ultimately, is cheaper than the existing methods of chlorination and fluoridation. Research has determined that the use of chlorine results in chemicals known as disinfection by-products. These by-products may be carcinogenic or have other toxicological effects associated with consumption.

The new radiation process ensures that the water doesn't carry these properties, that quality is always consistent regardless of the inflow water quality, and, furthermore, quality doesn't deteriorate the further the water travels (as is known to happen with chlorine). The research claims that the water post-radiation treatment is entirely safe for drinking.

Radiation stations will be fitted at the Gumbark Recycled Water Treatment Plant as the first testing scenario.

Box 3. Project 3—Removing Fluoride from Drinking Water Supply.

Following a significant amount of lobbying from alternative health groups, the State government is under increasing pressure to remove fluoride from Melbourne's drinking water supply. In doing so, lobbyists argue that consumers could then make a choice about fluoride in water, rather than being forced to consume it.

The Water Minister would like to phase out fluoride in the water supply over the course of 12 months through decommissioning each of Melbourne's fluoridation stations. The first location where fluoridation will be ceased is at the Gumbark Recycled Water Treatment Plant.

The scenarios (Boxes 1–3) were chosen as "unfamiliar" projects that hadn't previously been undertaken in the Melbourne context. All the projects have contentious elements to them, such as drinking treated wastewater; the use of radiation, which carries negative connotations [8]; and the removal of fluoride, which can be socially sensitive [32].

3.4. Data Analysis

This paper's aim is to explore the risks that water utility experts perceive to be associated with new and innovative projects, and how risk perception differs across projects. Hence, a qualitative content approach, via a thematic analysis, was utilised to explore the data, as highlighted by the Framework approach developed by the National Centre for Social Research (UK) [33]. The first step involved undertaking "open coding" on the data, through generating an index of terms. This assumes no preconceived codes, allowing them to be developed from the data directly in an exploratory way [34]. This is used to find connections between the codes, and developing hypotheses with regard to the themes. The responses were double coded by two of the researchers to verify the findings. There were a small number of minor differences between the coders. These were discussed, then revised as a result of the discussion. Given that the survey responses were in written form, many of the responses provided were succinct.

Thematic analysis was then undertaken to consider the group of codes, arranging them into core themes and even further into subthemes [33]. These themes were then compared to themes highlighted in the literature, to determine whether they verify or contradict existing research. When searching for themes, we considered topics that seemed to reoccur, thus quantitatively analysing repetition. A focus on repetition is the most common measure for establishing a thematic pattern in the data and, thus, was used in this research [34]. Each project was analysed in this way. The themes were compared across projects to determine whether there may be any overall trends.

4. Results and Discussion

4.1. Identified Perceived Risks

Through the use of a qualitative content analysis approach, fourteen key risk factors were observed across respondents for each hypothetical water project. A brief description of each risk factor is found below:

- Public health—direct: This category included a direct statement from respondents about the potential public health risk associated with the project. For example, with the fluoride project, "*possible risk of increased dental health issues, especially kids that don't practice [sic] proper dental hygiene*" (Female Team Leader, 36–45 years of age).
- Process-related risk with public health implication: This category was used when a respondent identified a process-related issue that would have a public health implication, but that the public health implication was not directly stated. For example, in relation to the potable recycled water system, "*off specification water reaching potable system*" (Female Project Manager, 26–35 years of age).
- Community Opposition: Responses relating to community opposition highlight a risk from public backlash due to the project.

- Reputation: This risk factor refers to the reputation of the water authority, as this is how it is framed in the risk management processes of each water authority: "*public concern over health impacts leading to reputational damage*" (Male Divisional Manager, 36–45 years of age).
- Safety: Safety refers to construction-based safety issues and worker safety, as well as any general mentions of safety.
- Questioning Research/Research Not Tested: This category was used for responses that critiqued studies presented. For example, in relation to the use of radiation in the water treatment process, "*what research has been done to support findings? Scientific evidence to back up? Risk of unknown and lack of evidence to support the project*" (Female, 26–35 years of age).
- Cost: Any responses that mentioned financial considerations of risk to the project.
- Governance and Regulation: This risk factor grouped any responses relating to regulatory approvals, for example, "*project could go over time, approvals may not be granted on time*" (Male Team Leader, 26–35 years of age).
- Environmental: This refers to any responses that highlighted any risks to the environment due to the project. "*Environmental [sic] will be impacted if system fails*" (Male Divisional Manager, 46–55 years of age).
- New Technology: Responses in this category highlighted the new or unfamiliar risk related to the project.
- Operational: This risk factor included responses that referred to the way the technology would be run or operated.

4.2. Risk Perceptions across the Hypothetical Water Projects

4.2.1. Risk Perceptions for Project 1—Potable Recycled Water Use

The perceived risks associated with the potable recycled water use scenario can be found in Table 1. As can be seen, community opposition was mentioned by the majority of respondents when considering the inclusion of recycled water in the potable supply. This is not an unfounded concern, as studies have shown that public perceptions relating to drinking recycled water are generally negative [21]. This was followed by risk to the reputation of the organisation, which could be closely linked to the impression that the public would not be in favour of the project. As discussed in the literature review section of this paper, this could also be as a result of an increasing public distrust in expert risk perceptions. This distrust can lead to an increased chance of public backlash, as project-based decisions are scrutinised. This points to whether water professionals seem to be cognisant of the effect of community action on projects, and its potential to become a politicised issue in the media.

Table 1. Expert risk perceptions associated with the potable recycled water project, and frequency of occurrence.

Risks Raised by Respondents (*n* = 77)	***n***
1. Community Opposition	50
2. Reputation	37
3. Public Health—Process-Related	37
4. Public Health—Illness	31
5. Cost	14
6. Governance and Regulation	12
7. Safety	10
8. Operational	9
9. Environment	2

Unsurprisingly, public health is also a highly cited risk category, fearing risk of illness as a result of the use of treated wastewater in the drinking water supply. References to the environment featured the least, with financial and regulatory risk having a moderate influence.

4.2.2. Risk Perceptions for Project 2—Radiation Treatment of Potable Water

Radiation was used in this project to draw out any historically negative connotations associated with the technology. Unsurprisingly, as shown in Table 2, safety features as the highest risk factor while regulation was mentioned the least. Community opposition and reputation appear high on the list, which may be a result of an expected negative public response to the technology, a theory confirmed in work by Fischoff et al. on risk perceptions [31].

Table 2. Expert risk perceptions associated with the radiation-based treatment system for water, and frequency of occurrence.

Risks Raised by Respondents (n = 76)	n
1. Safety	31
2. Community Opposition	29
3. Reputation	22
4. Questioning Research/Research Not Tested	21
5. Public Health—Illness	20
6. Public Health—Process-Related	17
7. Environment	11
8. New Technology	11
9. Operational	9
10. Governance and Regulation	2

The theme of questioning established research appeared as a risk factor for Project 2, which could be either interpreted as distrust of research, or healthy scrutiny of previous studies. In much the same way as the community expects to be engaged on projects, water professionals expect further information and reassurance from researchers. Interestingly, public health did not feature as high in responses, even though this was a new method altering the existing water treatment processes.

4.2.3. Risk Perceptions for Project 3—Removal of Fluoride from Potable Water Source

As shown in Table 3, project 3 had the highest mention of public health as a risk factor, which could be interpreted due to the nature of the removal of a dosing process, rather than the addition of a process (as occurs with the other projects). Most respondents were concerned about the effect on dental health if fluoride was removed, for example, "*possible risk of increased dental health issues, especially kids that don't practice proper dental hygiene*" (Female Team Leader, 36–45 years old).

Table 3. Expert risk perceptions associated with the removal of fluoride from the potable supply, and frequency of occurrence.

Risks Raised by Respondents (n = 75)	n
1. Public Health—Illness	46
2. Community Opposition	27
3. Reputation	25
4. Cost	12
5. Safety	8
6. Governance and Regulation	4
7. Environment	2
8. Public Health—Process-Related	2

Many respondents also mentioned the issue of pro-fluoride groups protesting, while others highlighted that they will be seen as "giving in", "giving luddites victory" (Male Project Manager, 36–45 years old), and heeding a movement not backed by evidence:

> *"It's not based on science, it's based on the opinion of people (generally) that have a poor understanding of science. These decisions need to be backed by science. It's a poor response to the problem and focuses on pleasing minorities at the expense of legitimate health benefits for everyone else. Why not allow minorities to use household based filters to remove the fluoride?"* (Male, 18–25 years old)

These comments highlight the controversial nature of the project and the opinions of the vocal minority in the community.

4.3. Risk Perceptions—A Comparison between the Hypothetical Water Projects

As shown in Figure 1, "community opposition" and reputation featured consistently across all projects, while public health impacts also played a large role in risk perceptions.

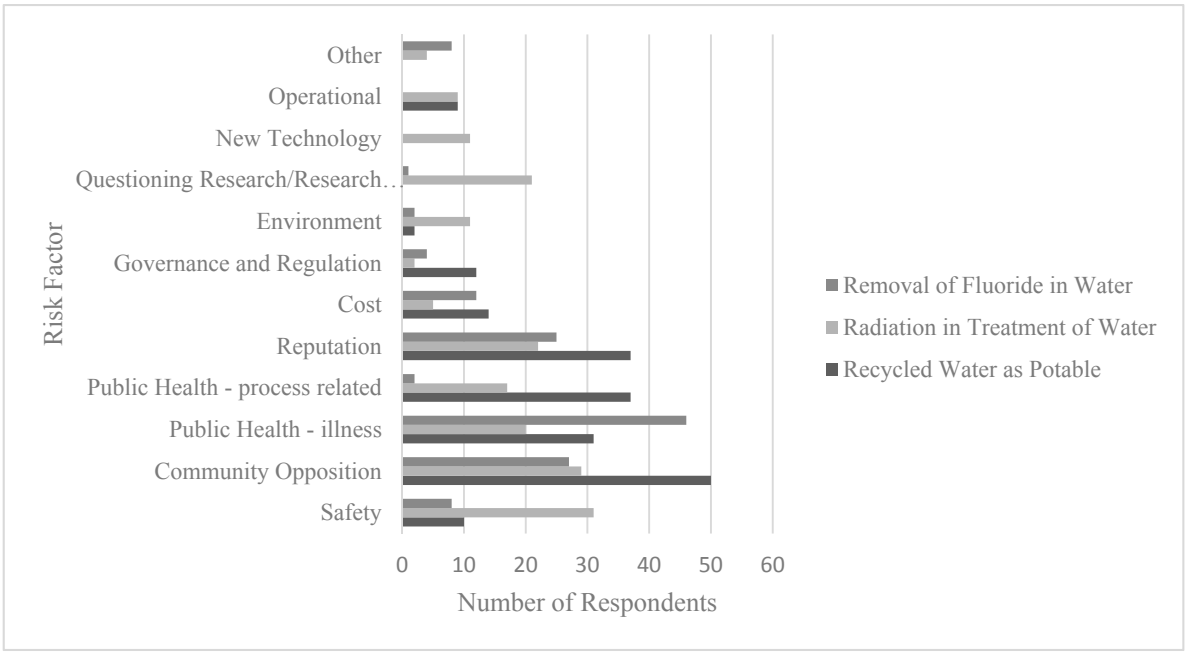

Figure 1. Water professionals' risk perceptions by project.

Community opposition was a risk factor that featured most prevalently across all projects. This was taken to refer to a negative public perception of the project that ultimately led to some form of protest or action. This is not surprising in a participatory democracy, especially as the water authorities have the state government as their key stakeholder. A focus towards active public decision-making has become a larger feature in the way water projects are managed in Australia [35], and, therefore, community opposition is shown to be front of mind in managing project risks.

While the fact that the majority of the respondents had technical backgrounds (either in engineering or in operations), two of the three main risks highlighted were not technical in nature, but social. The highest risk noted is the perception that community backlash could alter or stop new or unfamiliar projects from proceeding. This was raised for all of the three projects, but had more responses for the potable recycled water project scenario. To address this perceived risk, water practitioners could place a high emphasis on engaging the community early in the project. This also highlights the varied role of engineers and operational staff in considering public sentiment and social relations in

their historically technical position. There is a potential need for greater in-house expertise on the public communications side of the project planning and implementation.

Risk to the reputation of the water authority also featured highly in the findings across each of the projects. Engaging government stakeholders early, while also managing media effectively, could help mitigate reputation-based risk. The risk to reputation is a factor that relates to trust in the water authority [22]. Conducting trust-building activities between water practitioners and the public provides a solution to counter the effects of distrust towards experts.

One area of difference between projects was for the issue of safety. For the radiation-treated water, this was raised by over 30 participants, but was raised by 10 or under for the other projects. The process of the radiation treatment of the water gave rise to a greater number of perceived risks associated with safety and

> "*operational risks, operators being exposed to high levels of radiation, long term effects vs. immediate effects of this on operators and in water supply*" (Female Project Manager 18–25 years of age)

> "*unknown long-term exposure to radiation catastrophic failure of radiation facility, risk of harm to the environment, fatality*" (Male, 26–35 years of age)

Cost does not feature highly in the risk perception findings, yet it plays a large role in business case development. This is in contrast to West's study [26,28], which highlighted cost as a major risk factor. An interpretation could be that the difference existed in the familiarity or unfamiliarity of projects presented.

4.4. Risk Perception—A Comparison with Existing Literature

The results differ to those of studies by both West et al. and Dobbie et al. on risk perceptions of water practitioners in Australia. Both studies showed cost to be the major risk factor identified in water projects, with customer complaints coming in at third. Boholm and Prutzer's Swedish study on the same topic found the two main risks identified by experts in water projects were delivery failure and quality failure [36]. Although "operational" issues did feature in our study, it was not a dominant risk factor (unlike in the Swedish context).

Interestingly, West's study did not include "safety" as a risk factor (despite 34 other factors being assessed). In our results, either construction/worker safety or general safety featured 31 times for project 2 (radiation), while in projects 1 and 3 the concept featured 10 and 9 times, respectively. The word "fatality", or similar, appeared three times in the data. The "availability heuristic" explored by Tversky and Kahneman might explain this focus on safety and fatalities [37]. Serious incidents in construction and operations within the water sector are communicated throughout the industry through either Worksafe (a state government safety authority) or through internal organisation processes. The availability heuristic highlights that if a particular issue comes to mind more readily, which occurs in the case of personal affiliation with a risk or experience with one, it is seen as riskier than those risks that do not carry this personal connection (even if both risks are seen as equally likely, with equal consequences) [37]. This may provide an explanation to the increased awareness of safety and the repeated mention of fatalities, if workers often either experience or speak about safety issues.

Public health also features in the risk attribute data; however, once again, it is not highlighted in West et al. as an area that water experts see as "high risk" [28]. Dobbie et al., instead, report public health to be a medium risk by experts in the case of potable reuse schemes [27]. Bolhom and Prutzer's study also found similar results [36]. West et al. argue that the high risk to public health is not revealed in comments because current risk assessment and management guidelines effectively address these issues [28]. As the issue of public health has arisen in all the projects assessed in this study, our interpretation is that this could be due to the risk assessor's unfamiliarity with the projects in question, as all are new and have never been undertaken at any of the water authorities that were part of the survey sample. A recycled water scheme, the issue addressed in West's study, is not

an uncommon innovation across water authorities in Australia, and their sample came from across the country. Therefore, it could be argued that their familiarity with the project may reduce perceived risk [28]. Shrader-Frechette highlights the phenomenon of uncertainty acting as a large factor in how risks are perceived, with higher uncertainty leading to higher risk perceptions [38]. As all three projects presented have elements of uncertainty, it may explain the role of safety and public health as major factors in perceived risk by water experts. In particular, the greatest uncertainty across the three projects was for the radiation project, which is arguably the least familiar for the respondents.

Limitations to the research exist. The findings presented in this study are based on written surveys. If the research had been undertaken in a focus group, or verbally, respondents may have been provided with the opportunity to introduce more contextual elements to their responses and further probing would have been possible. This presents an opportunity for further investigation into understanding relative features of each risk perception attribute, to fine-tune these results. Broadening the study to a water context broader than Melbourne would also be of interest.

These findings add to existing research by providing further understanding of expert risk perceptions for new and unfamiliar projects within the water industry. Growing and urbanizing populations increase the demand on existing water infrastructure, while a changing climate alters water supply levels, leading to challenges to the delivery of sufficient water to residents. New and innovative water practices must be adopted to address these changes.

5. Conclusions

As water resources continue to become strained due to both demand and supply issues, new and alternative water sources must be sought and implemented to retain water security. However, new technologies and processes may be discriminated against, in favor of existing business-as-usual methods. Experts' risk perceptions of unfamiliar water projects have been the central element in this study. It was found that experts are sensitive to community sentiment. Experts have also indicated concern about the water authorities' reputation. Previous studies into risk perceptions highlighted the difference between the risks perceived by a layperson and an expert. This study indicates that experts within Melbourne water authorities have concerns regarding what this public risk perception is, especially as it is likely to differ from their own. Experts then, do consider laypeople's views on these new and unfamiliar water projects. This can be linked to the public's effect on the water authority's key stakeholder, the state government. Studies such as Sjoberg and Drottz-Sjoberg show that risk perceptions by politicians are very similar to the public, both of which generally differ from those of experts [39]. As the government—and, therefore, politicians—are a key stakeholder of the water authority, public sentiment and opinion plays a role in driving water policy. Due to the nature of a participatory democracy, moving with, rather than past, public opinion is preferred.

For new and unfamiliar projects, water experts were found to consider other elements such as public health as high risk, yet this factor does not appear in other studies of business-as-usual projects, such as building a recycled water scheme. Safety as a predominant risk factor appears in these projects (yet didn't appear in other studies), while cost was not a theme that featured prominently in the data. Highlighting these risk factors paves the way to understanding potential barriers or risk aversion towards the take-up and approval of new and unfamiliar water projects in the future. These can then be considered when determining an organisational risk appetite statement, as well as updated risk assessment processes, for new projects, especially if the authority would like to promote new projects to combat a changing climate.

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