Hindering Factors of Innovativeness in Australian Water Utilities

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***This paper has been originated from the doctoral dissertation of the author, as part of his PhD program **.*

ABSTRACT:
Australia is the second driest continent, after Antarctica, on this planet.Continuous environmental threats, climate change, and increasing migration putting the water supply organizations in challenge ofincreasing water demand. Moreover, the Australian water utilities are very risk averse in nature which causes barriers to innovativeness along with some other crucial factors. This study aims to point out those hindering factors through focus group discussions and a questionnaire-based survey.
KEYWORDS: *Innovativeness, Water Service Delivery, Hindering Factors of Innovativeness, Qualitative Research, Focus Group Discussion, Quantitative Research, Survey.*

I. Introduction

Without water, human life is impossible [1],[2] and the main source of food, agriculture will be ruined without water [3]. Countries, even smaller societies cannot survive without water. Due to rapid environmental change [4], and population growth [5], the demand for water is creasing very fast [6], [7].

Hence, water utilities are facing immense challenges due to societal, biological, and mechanical issues, threatened by climate change, increasing pressure of migration and dwindling resources [8], [9] endangering long-term water security [10]. On the other hand, the water regulatory bodies have sought sustainable solutions in the long run [11].

The scenario becomes very vulnerable in the Australian context [12], particularly in dry seasons while handling bush fire [13].

To meet the challenges in water service delivery, related organizations must be agile [14] because organizational agility helps them to cope with these changes and challenges [15]. Such changes and challenges often work as drivers to innovativeness, which can help solve this crisis. While emphasizing that innovativeness is important in dynamic contexts, these water utilities must sense, plan and interpret outcomes accurately [16].

Innovativeness in water service delivery ranges from identifying new water sources to improving existing supply and consumption management with the aims of sustainable water security [17].

Water utilities are naturally cautious in pursuing innovation in water management as they are closely governed by the regulators, and sensitive to public health standards [18], [19]. Naturally, these organizations need to be agile for resilience to adopt changes, adapt to challenges and initiate innovations. This is because metropolitan water management must embrace resilience, emphasizing particular characteristics or forces of complicated socio-ecological systems [20]: assessing and improving water infrastructure using a resilience perspective has been found more productive [21].

Unfortunately, a research has proven that several critical factors for resilience towards innovativeness in water service delivery in Australia are highly disrupted and hampering smooth innovative process [22]. This research aims to figure out those hindering factors.

II. Factor of Innovativeness

In general the terms "factors of innovativeness" or "factors of organizational innovativeness" refer to those issues that have very direct impact on the organizational innovation performance [23]. They are those factors that enables organizations to be creative [24] and these factors must be cultivated properly through the organizational strategies, culture, structure, and different operations to ensure the innovative capabilities [25].

When these factors are nourished appropriately within the organizations, the organizations enjoy the competitive advantages [26] and growth in market share.

Researchers have found numerous factors that influence organizational innovativeness. In a research, 102 factors have been identified through a systematic literature review [22], [27].

All these factors may not be suitable for water sector, since they are non-profit and government-controlled organizations[28].

Therefore, firstly, it is necessary to find out the relevant factors of innovativeness in Australian water utilities. Then at the second stage, it is possible to figure out the hindering factors in innovation.

III.   Australian Water utilities

Understanding the warning from the experts for the adequate water supply to urban areas [29],for better management and service delivery, the Australian government has reformed water industry with metropolitan (urban) and council-based (rural/regional) water utilities [30], and so has two main types of water utilities. The first one is the Metropolitan Water Utility, which are in most cases, larger, autonomous and independent [31]. The second type is the Council governed water utility, which by comparison are relatively financially constrained and lack freedom in operations [32]. The literature has used the term "water utilities" in common for both types. In case of innovativeness, the Metropolitan water utilities are more likely to do better since they have more freedom than the Council utilities in their operations. This research addresses both these classes of utility, as they are involved in the same functions across Australia.

Since Australia is regarded as a very dry continent. The Commonwealth government introduced Federal water reform policy in 1994; accordingly an Intergovernmental Agreement detached privileges for water from land ownership and allowed water trading [33]. This agreement paved the way to establish a structure in water management for agriculture and urban use, and also for recycling water.

The Department of Agriculture and Water Resources controls water legislation in Australia through the following legal instruments [34]:
   a)   Water Act 2007
   b)   Water Efficiency Labelling and Standards Act 2005
   c)   Water Regulations 2008 and
   d)   Water Charges and Water Market Rules

Additionally, several departments of the Australian Government are playing roles in assisting and guiding water reform agenda; the Council of Australian Governments is in charge of water policy reform that necessitate supportive actions by the Government, and the National Water Initiative, the primary agreement for water policy, provides the water reform blue print [34]. The Australian Government considers the inputs from the community and engages them with related stakeholders through different forums, at local, national and even international levels [34]. Moreover, in May 2015, through the Department of Foreign Affairs and Trade, the Australian Water Partnership has been established for sharing their expertise with Indo-Pacific Region, where international partners reinforce water proficiency and deliver schemes for use in provincial water issues [34].

IV.   Methodology

The basic research methods are qualitative, quantitative, and mixed method, and in this research, mixed research method integrates components of both qualitative and quantitative approaches [35] and directs towards research design analysis through merging, connecting or implanting the data that provide a solider insight of the research question and research objectives [35].

This research is using both the qualitative and quantitative methods. Firstly, using qualitative method to discuss the factors relating to the Australian water utilities[36] through focus group discussions [37],results in most relevant factors[38], [39].

The focus group discussions not only result in identifying the most relevant factors, but also contribute in developing a survey questionnaire.

Due to newly developed questionnaire, it was a must to conduct a pilot study with at least 30 respondents [40], [41] to ensure the validity and reliability of the questionnaire. 35 people participated in the pilot survey and resulted in the value of 0.914 (Table 1 in Appendix) as Cronbach Alpha. As the value of Cronbach Alpha was higher than 0.80, the questionnaire was reliable and valid [42], [43], [44].

Later, using survey as quantitative research method identifies the factors [45], [46], [47], [48] which are hindering the organizational innovativeness in the Australian water utilities.

The survey questionnaire was distributed among all the employees of Australian water sector through SurveyMonkey. The total population (number of people working in Australian water utilities) was around 30,100 [49]. Using the sampling calculator, the required sample size was 380 [50]; considering 95% level of confidence and 5% confidence interval in a random sampling technique.

In the nationwide survey, total 524 responses were received. But 24 responses were incomplete and 35 were partially complete, so these 59 (24+35) responses were not considered. Thus, the acceptable sample size became 465, which is higher than the required.

V. Qualitative Discussion

For identifying the most relevant factors of organizational innovativeness in the Australian water utilities, 3 focus group discussions were held.

The entire research was done during COVID pandemic, therefore, all the discussions held through Zoom meetings. The innovation managers working in the water utilities across Australia participated in the discussions. The average size of the 3 focus group discussions was 12, which is satisfactory and acceptable [51] ,[52], [53].

All the participants in the focus group discussions intensively concentrate on the 102 factors, identified the researchers [27], [22]. After a very deep insight and conversation, all the participants agreed on 16 most critical factors which play the most influential roles in innovativeness in water utilities. The factors are Idea Generation, Teamwork, Clients' Requirements, Organizational Resources, Vision, Industry Relationships, Training and Development, Delegation, Use of ICT, Motivation, Brand Advertisement, Managing Knowledge for Innovation, Culture for Creativity, Capital Resources, Regulators' Influence: Changes in Work, Regulators' Influence: Improvement in Work. Beside this, the members of the focus group also analyzed the measuring factors of innovativeness and agreed on 5 such factors. The measuring factors are Frequency of Innovative Change Benefits of Innovative Change Speed of Innovative Change Experience of Innovative Change Risks associated with Innovative Change.

After finalizing and endorsing the 16 influencing factors, the focus group members contributed in developing a survey questionnaire for further study.

VI. Quantitative Discussion

As discussed in methodology, the questionnaire was validated and reliable with the value of Cronbach Alpha, and the sample size was good, therefore, there was no issue to advance the research with quantitative formatted through survey.

IBM SPSS 27 was widely used in analyzing the data collected through survey questionnaire.

At the very beginning, it was necessary to examine the existence of the 16 influencing factors in Australian water utilities. In this regard, descriptive statistics was used because it guided the researchers in determining the frequency in a distribution, which usually measured through the mean values [54], [55], [56]. Table 2 in the appendix illustrates the result of the descriptive analysis. From the result, it was clearly found that none of the influencing factors was completely present in the Australian water utilities. Among 16 factors, Customers' Requirements (7.8022), Regulators' Influence: Change in Work (7.4043), Teamwork (7.0753), and Culture for Creativity (6.9462) were at the top, which can be considered as existing at high level. Besides, Training and Development (5.6559), Regulators' Influence: Improvements in Work (5.6903), Capital Resources (5.7204) were existing at just below average level.

Now, through multiple linear regression analyses, the hindering factors can be identified, because, the correlations between the influencing and measuring factors is highly preferred through multiple linear regression analyses [57], [58], [59], [60].

Furthermore, multiple regression analyses would be executed because it used to establish the relationships among the factors of the organization innovativeness for service delivery and the measuring factors of innovation activities through the multiple linear regression models [61], [62], [63].

Before conducting the multiple linear regression analyses, it was essential to examine the inter-relationships among the influencing factors (independent variables) and measuring factors (dependent variables) [64], [65], and it was a prerequisite for conducting multiple linear regression analyses [66], [67]. Table 3 in the appendix, illustrates the Pearson Correlations among the influencing and measuring factors. According to the correlation matrix, all the factors/variables were highly correlated, while the almost all were at 99% level of confidence, and only a few were at 95% level.

After conducting multiple linear regression analyses for 5 measuring factors (dependent variables), 9 influencing factors (independent variables) were found impacting the innovativeness measures (Table 4 in Appendix). According to the Table 4, 7 influencing factors, e.g., Culture for Creativity Delegation Motivation Managing knowledge for innovation Brand Advertisement Customers' Requirements, positively impacted the measures of innovativeness while other 2 factors, e.g., Regulators' Influence: Change in Work, Training and Development, negatively impacted the innovativeness.

While conducting multiple regression analyses for managers and non-managers of the Australian water utilities,several other factors were identified as impacting negatively (Table 5 in Appendix), e.g., Idea

Generation,Customers' Requirements,Capital Resources, Industry Relationships,Teamwork,Regulators' Influence: Improvements in Work.

Hence, through the quantitative survey revealed a total of 8 factors, e.g., Idea Generation,Customers' Requirements,Training and Development,Capital Resources, Industry Relationships,Teamwork,Regulators' Influence: Change in Work,Regulators' Influence: Improvements in Work; were negatively affecting the innovative capabilities of the Australian water utilities.

Therefore, these 8 factors can be classified as hindering factors of innovativeness in the water utilities across Australia.

VII. Conclusion

The result of descriptives, denotes an alarming situation in relation to innovativeness of the water utilities, as the essential factors of organizational innovativeness are not adequately present. Such situation reduces the innovative capabilities of the water utilities in delivering their services.

In addition to that, identified 8 hindering factors, e.g., Idea Generation,Customers' Requirements,Training and Development,Capital Resources, Industry Relationships,Teamwork,Regulators' Influence: Change in Work,Regulators' Influence: Improvements in Work; have been restricting the Australian water utilities to initiate, and definitely, to develop innovation strategies to overcome the challenges of satisfying the increasing demand for water.

The research is limited in Australian context. But it has two major implications. Firstly, it contributes to the body of knowledge with limiting factors of innovative capabilities. Secondly, the practicing managers in the Australian water utilities can address these hindering factors to eliminate their negative impacts.

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Appendix

Reliability Statistics	
Cronbach's Alpha	N of Items
.914	21

(**Table –1** : Reliability Statistics with Cronbach Alpha Value)

Descriptive Statistics for 465 Responses					
INFLUENCING FACTORS	N	Minimum	Maximum	**MEAN**	Std. Dev.
Customers' Requirements	465	1	10	**7.8022**	1.72319
Regulators' Influence: Change in Work	465	1	10	**7.4043**	1.85346
Teamwork	465	1	10	**7.0753**	2.00558
Culture for Creativity	465	1	10	**6.9462**	1.7281
Delegation	465	1	10	**6.7978**	2.28516
Vision	465	1	10	**6.7699**	2.08669
Industry Relationships	465	1	10	**6.6774**	1.78693
Organizational Resources	465	1	10	**6.4172**	2.14509
Motivation	465	1	10	**6.2473**	2.23826
Managing knowledge for innovation	465	1	10	**6.2430**	2.02012
Use of ICT	465	1	10	**6.2344**	2.22904
Brand Advertisement	465	1	10	**6.2108**	2.22996
Idea Generation	465	1	10	**6.0817**	2.10546
Capital Resources	465	1	10	**5.7204**	2.29301
Regulators' Influence: Improvements in Work	465	1	10	**5.6903**	1.94061
Training and Development	465	1	10	**5.6559**	2.41357
Valid N (listwise)	465				

(**Table – 2** : Descriptive Statistics of All Responses – Output through IBM SPSS 27)

		Culture for Creativity	Idea Generation	Customers' Requirements	Capital Resources	Industry Relationships	Use of ICT	Teamwork	Delegation	Vision	Regulators' Influence: Change in work	Regulators' Influence: Improvements in Work	Motivation	Organisational Resources	Training and Development	Brand	Managing knowledge for innovation	Frequency of Innovative Change	Benefit of Innovative Change	Speed of Innovative Change	Experience of Innovative Change	Risks associated with Innovative Change
Culture for Creativity	Pearson Correlation	1	.541**	.515**	.439**	.474**	.442**	.523**	.505**	.508**	.270**	.293**	.543**	.486**	.434**	.454**	.452**	.504**	.359**	.378**	.404**	.247**
Idea Generation	Pearson Correlation	.541**	1	.511**	.502**	.462**	.527**	.567**	.601**	.668**	.255**	.377**	.710**	.579**	.622**	.547**	.560**	.502**	.344**	.447**	.274**	.252**
Customers' Requirements	Pearson Correlation	.515**	.511**	1	.470**	.487**	.420**	.476**	.452**	.497**	.325**	.341**	.506**	.489**	.438**	.574**	.455**	.394**	.240**	.323**	.343**	.204**
Capital Resources	Pearson Correlation	.439**	.502**	.470**	1	.482**	.509**	.437**	.457**	.535**	.240**	.337**	.505**	.567**	.562**	.431**	.486**	.446**	.235**	.337**	.253**	.259**
Industry Relationships	Pearson Correlation	.474**	.462**	.487**	.482**	1	.457**	.501**	.480**	.526**	.255**	.304**	.532**	.484**	.477**	.505**	.524**	.411**	.261**	.369**	.280**	.251**
Use of ICT	Pearson Correlation	.442**	.527**	.420**	.509**	.457**	1	.545**	.517**	.465**	.248**	.350**	.520**	.744**	.565**	.467**	.554**	.441**	.264**	.380**	.231**	.228**
Teamwork	Pearson Correlation	.523**	.567**	.476**	.437**	.501**	.545**	1	.657**	.555**	.355**	.388**	.617**	.613**	.556**	.496**	.513**	.521**	.340**	.372**	.270**	.313**
Delegation	Pearson Correlation	.505**	.601**	.452**	.457**	.480**	.517**	.657**	1	.635**	.280**	.316**	.687**	.632**	.550**	.488**	.561**	.579**	.381**	.460**	.295**	.263**
Vision	Pearson Correlation	.508**	.668**	.497**	.535**	.526**	.465**	.555**	.635**	1	.289**	.363**	.665**	.548**	.564**	.601**	.579**	.498**	.356**	.426**	.290**	.279**
Regulators' Influence: Change in work	Pearson Correlation	.270**	.255**	.325**	.240**	.255**	.248**	.355**	.280**	.289**	1	.340**	.331**	.334**	.265**	.298**	.235**	.270**	.111*	.120**	.187**	.143**
Regulators' Influence: Improvements in Work	Pearson Correlation	.293**	.377**	.341**	.337**	.304**	.350**	.388**	.316**	.363**	.340**	1	.383**	.334**	.350**	.377**	.385**	.306**	.247**	.293**	.191**	.218**

(**Table – 3** : Correlation among all independent variables and dependent variables)

CORRELATIONS AMONG INFLUENCING FACTORS AND MEASURING FACTORS

		Culture for Creativity	Idea Generation	Customers' Requirements	Capital Resources	Industry Relationships	Use of ICT	Teamwork	Delegation	Vision	Regulators' Influence: Change in work	Regulators' Influence: Improvements in Work	Motivation	Organizational Resources	Training and Development	Brand	Managing knowledge for innovation	Frequency of Innovative Change	Benefit of Innovative Change	Speed of Innovative Change	Experience of Innovative Change	Risks associated with Innovative Change
Motivation	Pearson Correlation	.543**	.710**	.506**	.505**	.532**	.520**	.617**	.687**	.665**	.331**	.383**	1	.661**	.652**	.607**	.643**	.609**	.446**	.527**	.372**	.338**
Organizational Resources	Pearson Correlation	.486**	.579**	.489**	.567**	.484**	.744**	.613**	.632**	.548**	.334**	.334**	.661**	1	.699**	.567**	.618**	.531**	.335**	.436**	.283**	.299**
Training and Development	Pearson Correlation	.434**	.622**	.438**	.562**	.477**	.565**	.556**	.550**	.564**	.265**	.350**	.652**	.699**	1	.583**	.675**	.534**	.326**	.441**	.226**	.295**
Brand	Pearson Correlation	.454**	.547**	.574**	.431**	.505**	.467**	.496**	.488**	.601**	.298**	.377**	.607**	.567**	.583**	1	.575**	.476**	.379**	.444**	.291**	.288**
Managing knowledge for innovation	Pearson Correlation	.452**	.560**	.455**	.486**	.524**	.554**	.513**	.561**	.579**	.235**	.385**	.643**	.618**	.675**	.575**	1	.534**	.379**	.466**	.341**	.243**
Frequency of Innovative Change	Pearson Correlation	.504**	.502**	.394**	.446**	.411**	.441**	.521**	.579**	.498**	.270**	.306**	.609**	.531**	.534**	.476**	.534**	1	.525**	.548**	.431**	.189**
Benefit of Innovative Change	Pearson Correlation	.359**	.344**	.240**	.235**	.261**	.264**	.340**	.381**	.356**	.111*	.247**	.446**	.335**	.326**	.379**	.379**	.525**	1	.662**	.473**	.260**
Speed of Innovative Change	Pearson Correlation	.378**	.447**	.323**	.337**	.369**	.380**	.372**	.460**	.426**	.120**	.293**	.527**	.436**	.441**	.444**	.466**	.548**	.662**	1	.457**	.254**
Experience of Innovative Change	Pearson Correlation	.404**	.274**	.343**	.253**	.280**	.231**	.270**	.295**	.290**	.187**	.191**	.372**	.283**	.226**	.291**	.341**	.431**	.473**	.457**	1	.194**
Risks associated with Innovative Change	Pearson Correlation	.247**	.252**	.204**	.259**	.251**	.228**	.313**	.263**	.279**	.143**	.218**	.338**	.299**	.295**	.288**	.243**	.189**	.260**	.254**	.194**	1

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

(**Table – 3** : Correlation among all independent variables and dependent variables)

Summary of Multiple Linear Regression Analyses – Figuring out the most crucial influencing factors against measuring factors

	Dependent Variables	Frequency of Innovative Change			Benefits of Innovative Change			Speed of Innovative Change			Experience of Innovative Change			Risk associated with Innovative Change		
Serial	Independent Variables	Sig.	B	Beta	Sig.	B	Beta	Sig.	B	Beta	Sig.	B	Beta	Sig.	B	Beta
01.	Culture for Creativity	0.000	0.212	0.111	0.003	0.160	0.163				0.000	0.259	0.254			
02.	Delegation	0.000	0.186	0.206				0.029	0.112	0.134						
03.	Motivation	0.001	0.199	0.197	0.001	0.184	0.243	0.001	0.198	0.233	0.005	0.166	0.211	0.025	0.148	0.176
04	Managing knowledge for innovation	0.036	0.119	0.111							0.005	0.160	0.184			
05.	Brand				0.008	0.123	0.163	0.023	0.111	0.130						
06.	Regulators' Influence: Change in Work							0.016	-0.107	-0.104						
07.	Customers' Requirements										0.025	0.131	0.128			
08.	Training and Development										0.040	-0.104	-0.143			
09.	Teamwork													0.049	0.123	0.131

(**Table – 4** : Summary of Multiple Linear Regression analyses, showing significant independent variables against the dependent variables)

Regression Analyses – Comparison between Responses from Managers and Non-Managers

Dependent Variables →	Frequency of Innovative Change				Benefit of Innovative Change				Speed of Innovative Change				Experience of Innovative Change				Risks associated with Innovative Change			
Managers vs. Non-Managers →	Managers		Non-Managers		Managers		Non-Managers		Managers		Non-Managers		Managers		Non-Managers		Managers		Non-Managers	
Independent Variables	Sig.	B	Sig.	B	Sig.	B	Sig.	B	Sig.	B	Sig.	B	Sig.	B	Sig.	B	Sig.	B	Sig.	B
Culture for Creativity	0.038	0.208	0.012	0.176			0.030	0.150					0.001	0.320	0.005	0.206				
Idea Generation																	0.032	-0.275		
Customers' Requirements					0.046	-0.174									0.021	0.173				
Capital Resources			0.013	0.142	0.030	-0.139			0.002	-0.216										
Industry Relationships	0.029	-0.232																		
Use of ICT																				
Teamwork	0.002	0.337							0.014	0.247	0.025	-0.152								
Delegation	0.038	0.197	0.009	0.163																
Vision																				
Regulators' Influence: Change in Work											0.033	-0.119								
Regulators' Influence: Improvements in Work	0.046	-0.156																		
Motivation	0.011	0.287			0.001	0.322			0.003	0.322					0.019	0.175	0.050	0.266		
Organizational Resources																				
Training and Development																				
Brand											0.023	0.135								
Managing knowledge for innovation			0.002	0.219			0.015	0.170					0.001	0.304						

(**Table – 5** :Regression Summary for Managers' and Non-Managers' Responses)