EFFECTIVE RISK MANAGEMENT PRACTICE AND PROJECT SUCCESS, THE CASE OF A WATER UTILITY'S CONSTRUCTION PROJECTS

B. Javani[1*], H. G. Mamena[2] and M. Dewa[3]
[1*]School of Business Leadership
University of South Africa, South Africa
javanib@yahoo.com

[2]School of Business Leadership
University of South Africa, South Africa
mamenahg@gmail.com

[3]Department of Industrial Engineering
Durban University of Technology, South Africa
mendond@dut.ac.za

ABSTRACT

Failure to complete projects can significantly put an organisation's competitive advantage, its strategic position, and competitive survival in jeopardy. The study sought to establish the effectiveness of applying project risk management tools and techniques at Rand Water, a state-owned entity. A quantitative approach with a survey research strategy was used in this study and 63 of the total population of 69 responded to the questionnaire that was issued. The Rand Water case study findings suggest that, in order to reduce project failure, one of the tools being utilized in managing projects is effective project risk management. In addition, the findings indicate that executive management must continue to apply project risk management tools and techniques coupled with regular project team training.

Keywords: Construction Projects, Project Risk Management, Project Success

* Corresponding Author

1 CONTEXT

1.1 Background

Rand Water is the largest bulk water utility in Africa and is one of the largest water utilities in the world, providing bulk potable water by operating thirteen tertiary pumping stations, enclosed reservoirs, secondary booster stations and multi-billion rand regional pipeline network. It is imperative for Rand water to maintain a global reputation for providing high-quality water that ranks among the best in the world. Project management is critical for Rand Water to consistently met national standards and international guidelines on water quality. Kerzner [1] notes that project management has evolved from a set of processes that were once considered "nice to have" to a structured methodology that is considered mandatory for the survival of every organisation. He further mentions that many organisations are now relying on project management which is assisting them to sustain and grow their businesses. This is supported by Hadjinicolaou et al. [2] who establish that projects have increasingly become organisations' strategic initiatives to implement changes and improve organisational performance. It can, therefore, be deduced that many organisations that are embarking on projects to implement capital investment. One such organisation is Rand Water, whose competitive advantage is dependent on successful completion of these projects. On the contrary, failure to complete such projects can significantly put an organisation's competitive advantage, its strategic position, and competitive survival in jeopardy.

1.2 Problem Statement

One notable aspect from the forgoing is that implementing strategy through projects is becoming the key for competitiveness. One notable aspect that comes with this is the management of project risk which is considered crucial once project success criteria has been agreed upon by all stakeholders [3]. Hence the effective application of project risk management is a possible significant contributor towards project success. It is against this background that the aim of this case study was to investigate the influence of project risk management on construction project success at Rand Water through a descriptive study.

2 LITERATURE REVIEW

2.1 Project Success

One irrefutable fact coming from literature review is that there is no consensus regarding the definition of project success. This was asserted by Carvalho et al. [4] who established that project success can be measured on different (i) projects, (ii) perspectives and (iii) stages. Thus, different project stakeholders understand project success differently [5]. Ramos and Mota [6] affirmed this by indicating that different stakeholders held deferent view regarding project success on the same project. For instance, senior management might view project success when it has achieved certain aspects, which might be contrary to end-user's viewpoint. Similarly, the same can happen between the project manager and end-users.

The definition of project success comprises of project success factors, project success criteria Masrom et al. [7], project success measures Satankar and Jain [8], project success metrics and project success outcome evaluations. Furthermore, Lech [9] established that the presence of project success factors increases the probability of project success. Due to the multidimensional nature of the definition of project success, Samset [10], Shenhar and Dvir [11] different stakeholders explore different perceptions. Samset (1998) indicates five success criteria of efficiency, effectiveness, impact of project on society, relevance to real need of society and sustainability. Shenhar and Dvir [11] puts forward five dimensions of project efficiency, impact on the customer, impact on the team, business and direct success and preparation for the future. Carvalho and Rabechini Junior [12] add the sustainability dimension which is linked to social and environmental aspects of projects.

The decision to classify a project success and failure is a subjective process [13]. Müller and Jugdev [14] describe project success as "predominately in the eyes of beholder", meaning different individual perspectives on the same project. Therefore, Joslin and Müller [15] state that this element of bias when evaluating project success, should be eliminated through stakeholder alignment on project success criteria and its adoption.

2.2 Project Risk Management

Project risk management is an organized means of identifying, measuring, developing, selecting, and managing options for handling project risk [1]. It encourages considering the future, anticipating what could go wrong and then developing contingency strategies to mitigate the risks established [1].

Szymański [16] outlines the following process of risk management throughout the project cycle:

- risk identification – identification of risks and determination of their sources
- risk analysis – risk assessment in terms of hazards and their consequences
- responding to risk - number of measures and mechanisms affecting the risk level
- risk monitoring – on-going assessment and information about the risk.

All these processes are equally important and need to be carried out continuously from initiation through to project close out stage [16]. This is supported by Thamhain [17] who indicate that project risk management is an iterative, on-going review process during the life of a project. In addition, Banaitiene and Banaitis [18] echo the same in that project risk management is a valuable iterative process to organisations when it is applied consistently during the lifecycle of the project [18]. The application of project risk management practice entails learning from past experiences and implementing them in future. Whilst is it the responsibility of the project manager, project teams to assist in this regard. The project team needs to agree on the appropriate tools and techniques to be used in managing project risks [1].

The above is consistent with findings by Willumsen et al. [19] who asserts that project risk management is a common and widely adopted project practice. In addition, Kerzner [1] found that for project-driven multinational organisations, risk management is of paramount importance. However, not all organisations, understand project risk management or its importance as it is sometimes viewed as an over-management expense on a project.

2.3 Project Risk Management Practices in Construction Projects

Asaad [20] defines construction project as a collaborative teamwork process wherein stakeholders have different interests, functions and objectives although they share the common goal of a successful project. Success of projects in the construction industry depends on the level of risk [21]. Construction project risk management is seen as being a comprehensive and methodical technique of identifying, analysing, and responding to risks to achieve the objectives of the project [22]. Serpella et al. [23] assert that for decades, the approach to managing risk in construction projects seems to have not produced favourable results. For instance, one common risk management practice in the construction industry is through the application contingencies (money) or floats (time) to manage risks. The latter practice has its own flaws and is not one size fits all for projects. In order to improve project risk management Serpella et al. [23] established that, it is necessary to use tried and tested, appropriate and systematic techniques [23]. The construction industry seems to present more unavoidable risks which require effective management throughout the project life cycle than any other project management industry [24][22]. Given that unpredictability in construction projects is unavoidable, it is imperative to effectively manage risks in construction projects if an organisation is to achieve its set objectives [25].

According to Choudhry and Iqbal [26], project risk management within the construction industry practice is responsive, semi-permanent, casual, and unstructured, resulting in a lack of capacity to effectively manage risks. The main barriers that were found include lack of formality of the process and lack of comprehensive methods applying project risk management [26]. In addition, Fan et al. [27] noticed that the same precision and urgency which is afforded to other knowledge areas of project management is not afforded to project risk management on construction projects.

2.4 Benefits of Applying Project Risk Management to Construction Industry

Asaad [20] identifies advantages of construction project risk management as follows:

- assisting achievement of projects objectives
- reducing capital cost of the project
- mitigating ambiguities
- Mitigating loss of time
- increasing stakeholders' reliability

Additional benefits from effective application of project risk management include financial savings, and greater productivity, improved success rates of new projects and better decision-making [25]. This implies that the construction industry should integrate the application of effective project risk management into their organisational culture. This would make it easier for employees to acquire appropriate skills and practice this knowledge subset [23].

2.5 Project Risk Management and Project Success

Project risk management has been found to have positive impact on project success [28]. However, not managing risk throughout the project lifecycle, can result in project failure [29]. As such, it is important to use project management tools and techniques to avoid project failures [33]. Effective risk assessment adds value through enhancing the probability of project success [30][31][32].

The construction process is a complex, nonlinear and dynamic phenomenon that may sometimes exist on the edge of chaos, hence the construction projects are rich in plan failure, delays, and cost overruns more than in successes [34]. However, Ortega [35] discovered that despite large project failure percentage, managers avoid discussing failure cases due to among others, the fear of harming the reputation of the parties involved. Besner and Hobbs [32] indicated that project failure is a sensitive issue which can impact the reputation of both the organisation and the team who worked on the project.

3 RESEARCH METHODOLOGY

3.1 Methodology

A positivist philosophy in the form of a quantitative descriptive study was adopted using a single case study on a water utility organisation. The study premise was based on Leavy [36] who indicate that deductive approaches are aimed at proving, disproving, or lending credence to existing theories. Considering a limited population of 69 project managers and project team members that Rand Water has, a census was adopted for this study in which all project managers and project team members (engineers, technicians, project planners) voluntary participated in this study. This meant that all Rand Water project managers and project team members had equal chance of being selected for participation in the study, which ensured unbiased and objective outcome. Ultimately, 63 of the 69 participated giving a 90% high response rate.

The unit of analysis was Rand Water's project managers, project team members. 15 (24%) had project management experience of between 2 - 10 years; 41 (65%) had experience of between

11 – 20 years while 7 (11%) had more than 20 years' experience. This case study of Rand Water made use of a questionnaire as data collection instrument, using a Five-Point Likert scale. Data was analysed using SPSS (Statistical Package for Social Sciences).

Cronbach's alpha was used to measure the consistency of responses across a set of questions (scale items shown in Appendix A) designed together to measure a particular concept (scale). The guidelines proposed by Saunders et al. [37] wherein Cronbach alpha ≥ 0.9 is excellent; ≥ 0.7 is good and ≥ 0.6 is acceptable were used.

Table 1: Research objectives and reliability coefficient

Objective	Number of Items	Cronbach's Alpha
To establish the relationship between project risk management and projects success in water utility projects.	6	0.62
To establish how project failures can be mitigated in the construction industry's water utility projects.	5	0.83
To establish the impact of effective project risk management in the construction industry's water utility projects.	8	0.81

3.2 Case Description

The case organisation herein referred to as Rand Water operates under the parameters of the Water Services Act no. 108 of 1997 and it is mandated to supply potable water in bulk to municipalities within its operational area [38]. The primary function of Rand Water is to use its infrastructure to extract raw undrinkable water from a river/dam, purify it to drinkable standard and then distribute through its infrastructure to municipal clients and private entities such as mines [38].

Rand Water's has a vast network of pipes spanning over 3 056 kilometers, over 58 reservoirs, purification plants that are all over Gauteng, Free State, North West and Mapumalanga provinces [38]. The case organisation has embarked on an investment programme comprising of more than 23 major projects running concurrently. The strategic intent is to increase the capacity of the raw water supply system from the Vaal Dam to the Zuikerbosch Water Purification and Pumping Station (the construction site of these 23 concurrently projects in Vereeniging) [23]. Successful completion of these projects will result in a potential revenue increase of 25% [38].

4 RESULTS

4.1 To establish the relationship between project risk management and projects success in water utility projects

Spearman-Brown Adjustment Split-half correlation is 0.71 suggesting a 71% confidence on the extent to which all the questions measure the relationship between project risk management and project success. The Cronbach's Alpha (CA) was used to determine the correlation between questions on project risk management and project success, thus checking the consistency of responses. In this case, a CA of 0.62 indicates an acceptable correlation and consistency.

Table 2: Statistical summary of reliability tests

Number of questions	6
Subjects	63
Cronbach's Alpha	0.62
Split-Half (odd-even) Correlation	0.54
Split-Half with Spearman-Brown Adjustment	0.71
Mean for Test	23.69
Standard Deviation for Test	4.59

The statistical summary is presented in Table 2. The null hypothesis is that all classification levels of opinion on the relationship between project risk management and project success has the same frequency while the alternative hypothesis is that there is a significant difference between the two at 1% (0.01) significant level. From the Chi-squared test, the calculated P-value of 2.56E-4 is smaller than the 0.01 level of significance. This implies that there are statistically significant differences between the frequencies of opinions with regards to the relationship between project risk management and project success. The null hypothesis is therefore rejected, and alternative hypothesis is accepted.

Table 3: Statistical summary of relationship between project risk management and project success

	Project Risk Management and Project Success								
	Strongly agree	**Agree**	**Neutral**	**Strongly disagree**	**Disagree**	**n**	**Mean**	**Stdev**	**P-value**
Frequency	45	136	102	68	27	378	2.7	1.20	2.56E-4
Percentage	12%	36%	27%	18%	6%				
Likert scale: 1 Strongly agree; 2 - Agree; 3 - Neutral; 4 - Strongly disagree; 5 – Disagree level of significance p <1% (2- Tailed)									

Table 3 represents the overall results on project risk management and project success. The mean value of 2.7 is between 2 and 3 on the Likert scale. The results indicate that, 36% and 27% of the participants had a neutral and agree opinion about the relationship between project risk management and project success.

4.2 To establish how project failures can be mitigated in the construction industry's water utility projects

Spearman-Brown Adjustment Split-half correlation of 0.79 was found, suggesting that there is a 79% confidence on the extent to which all the questions measure project failure mitigation. The Cronbach's Alpha of 0.83 indicates a good correlation and consistency.

Table 4: Statistical summary of reliability tests for project failure mitigation

Number of questions	5
Subjects	63
Cronbach's Alpha	0.83
Split-Half (odd-even) Correlation	0.63
Split-Half with Spearman-Brown Adjustment	0.79
Mean for Test	14.18
Standard Deviation for Test	3.48

The null hypothesis is that all project failures cannot be mitigated while the alternative hypothesis is that they can at 1% (0.01) significant level. From the Chi-squared test, the calculated P-value of 4.44E-7 is smaller than the 0.01 level of significant. This implies that project failures can be mitigated. The null hypothesis is therefore rejected, and alternative hypothesis is accepted.

Table 5: Statistical summary of frequency distribution for responses to questions on project failure mitigation

	Strongly agree	Agree	Neutral	Strongly disagree	Disagree	n	Mean	Stdev	P-value
Frequency	13	123	126	19	34	315	2.72	1.01	4.44E-7
Percentage	4%	39%	40%	6%	11%				
Likert scale: 1 Strongly agree; 2 - Agree; 3 - Neutral; 4 - Strongly disagree; 5 – Disagree Level of significance p <1% (2- tailed)									

Table 5 represents the overall results on project failure mitigation. The mean value of 2.72 is between 2 and 3 on the Likert scale. Results indicate that 40% and 39% of the participants had a neutral and agree opinion respectively about project failure mitigation.

4.3 To establish the impact of effective project risk management in the construction industry's water utility projects

As shown in Table 6, Spearman-Brown Adjustment Split-half correlation is 0.72, suggesting that there is a 72% confidence on the extent to which all the questions measure effective project risk management. The Cronbach's Alpha of 0.81 indicates a good correlation and consistency.

Table 6: Statistical summary of reliability tests for responses to questions on effective project risk management

Number of questions	8
Subjects	100
Cronbach's Alpha	0.81
Split-Half (odd-even) Correlation	0.54
Split-Half with Spearman-Brown Adjustment	0.72
Mean for Test	23.62
Standard Deviation for Test	4.59

Table 7: Statistical summary of frequency distribution for responses to questions on effective project risk management

	Strongly agree	Agree	Neutral	Strongly disagree	Disagree	n	Mean	Stdev	P-value
Frequency	30	176	172	30	96	504	2.88	1.17	1.86E-7
Percentage	6%	35%	34%	6%	18%				
Likert scale: 1 Strongly agree; 2 - Agree; 3 - Neutral; 4 - Strongly disagree; 5 – Disagree									
level of significance p <1% (2- Tailed)									

Table 7 represents the overall results on effective project risk management. The mean value of 2.88 is between 2 and 3 on the Likert scale. Results indicate that 35% and 34% of the participants had a neutral and agree opinion on effective project risk management. From the Chi-squared test, the calculated P-value of 1.86E-7 is smaller than the 0.01 level of significant. This implies that effective project risk management has positive implications for construction projects. The null hypothesis is therefore rejected, and alternative hypothesis is accepted.

5 DISCUSSION

The case study findings were able to proffer the significant positive relationship between project risk management and projects success at Rand Water. This implies that, the more effective project risk management is applied, the more likely that the project will succeed. This assertion corroborates with findings from literature in that:

- Project risk management practises are found to have a positive impact on project success [28].
- The effective project risk assessment is critical for the success of the construction projects and the risk assessment is a vital part of the risk management [30].

The case study also established that construction project failures can be prevented with proper project risk management practices in place. However, the converse is true when there are no project risk management practices in place. This is supported by findings from Hwang et al. [29] who established that projects could result in the failure if risk is not managed throughout the project lifecycle. Pimchangthong and Boonjing [28] provided insights that applying effective project risk management would allow organisations to have a control of possible future risks whilst allowing them to proactively devise plans to manage these risks. This action can empower similar organisations to mitigate possible project failures through application of effective project risk management practices.

In addition, the case study results established that effective project risk management has positive implications for construction projects. This is in line with findings from Choudhry and Iqbal [26] who established that, application of effective project risk management practices enhanced the probability of project success. It can be concluded from this case study that application of effective project risk management translates into effective project management with enhanced possibility of project success in Rand Water's construction projects.

6 MANAGERIAL IMPLICATIONS

These aspects below concerning project risk management have implications for organisational management teams, workers, engineers, partners, and other stakeholders. As established through the case study, placing project risk management at the centre of all project operations enhancing the chances of project success, which in turn results in a competitive edge. The following recommendations and implications for change are generated from this case study:

- Organisations should make it compulsory for all its Project Managers, Project Engineers and Project Teams to possess project risk management knowledge and attendance of regular refresher courses to keep them abreast of developments in the area.
- Organisations should ensure effective application of project risk management processes and practices. This can be made compulsory through enhanced organisational policies and procedures. In addition, there is need for regular project reporting to include project risk reporting.
- Organisations should ensure that effective implementation of project risk management systems/processes becomes part of organisational culture.
- Organisations should make it mandatory to archive project risk management reports for future referral use. Similarly, that, during project initiation or planning, previously archived project risk management reports must be part of the key inputs.
- Executive management should drive a culture of project risk management across all project teams, which improves risk mitigation and enhance project success.

7 LIMITATIONS OF THE STUDY

This case study was confined to Rand Water construction projects, its information, and participants. The following organisations are excluded:

- The rest of the construction projects executed by other organisations other than Rand Water.
- Any organisation from any other sector other than the construction industry within South Africa.

The case study focus was on the effect of project risk management on project management on project success. The impact of other factors on project success was not considered in this case study. This case study focused on project risk management and did not address other areas that affect project management within organisations, for instance, finance, operations, and executive management, among others.

8 CONCLUSION

The research results demonstrated that there were statistically significant differences between the opinions of the project managers with regards to the relationship between project risk management and project success. The conclusion based on the case study is that there is a significant and positive relationship between project risk management and projects success in Rand Water projects. This implies that effective project risk management can enhance project success. Furthermore, effective project risk management can assist in mitigating failure in water utility projects.

9 REFERENCES

[1] Kerzner, H. 2018. Project Management Best Practices: Achieving Global Excellence, 4th Edition, Wiley.

[2] Hadjinicolaou, N. Dumrak, J. and Mostafa, S. 2018. Improving project success with project portfolio management practices, 8th International Conference on Engineering, Project, and Product Management (EPPM 2017), Lecture Notes in Mechanical Engineering, pp 56-66.

[3] Frefer, A.A. Mahmoud, M. Almamlook, R. 2018. Overview success criteria and critical success factors in project management, Industrial Engineering and Management, 7(1), pp 1-6.

[4] Carvalho, M.M. Patah, L.A. and Bido, D.S. 2015. Project management and its effects on project success: Cross-country and cross-industry comparisons, International Journal of Project Management, 33(7) pp1509-1522.

[5] Beleiu, I. Crisan, E. and Nistor, R. 2015. Main factors influencing project success, Interdisciplinary Management Research, 11, pp 59-72.

[6] Ramos, P.A. and Mota, C.M.M. 2015. Exploratory study regarding how cultural perspectives can influence the perceptions of project success in Brazilian companies, Production, 26(1), pp 1-10.

[7] Masrom, A.N. Rahin, M.H.I.A. Chen, G.K. and Yunus, R. 2015. Successful criteria for large infrastructure projects in Malaysia, Procedia Engineering, 125, pp 143-149.

[8] Satankar, P.P. and Jain, S.S. 2015. Study of success factors for real estate construction projects, International Research Journal of Engineering and Technology, 2(4), pp. 804-808.

[9] Lech, P. 2016. Causes and remedies for the dominant risk factors in enterprise system implementation projects: the consultants' perspective, SpringerPlus, 5(1), pp 1-12.

[10] Samset, K. 1998. Project Management in a High-Uncertainty Situation. Uncertainty, Risk and Project Management in International Development Project, The Norwegian University on Science and Technology.

[11] Shenhar, A. Dvir, D. 2007. Project success: a multidimensional concept. Long Range Planning, 34(6), pp 699-725.

[12] Carvalho, M.M. and Rabechini Junior, J. 2015. Impact of risk management on project performance: the importance of soft skills, International Journal of Production Research, vol. 53(2), pp 321-340.

[13] Ika, L.A. 2009. Project success as a topic in project management journals, Project Management Journal, 40(4), pp. 6–19.

[14] Müller, R. and Jugdev, K. 2012. Critical success factors in projects: Pinto, Slevin, and Prescott – the elucidation of project success, International Journal of Managing Projects in Business, 5(4), pp 757-775.

[15] Joslin and Müller, R. 2015. Relationships between a project management methodology and project success in different project governance contexts, International Journal of Project Management, 33(6), 1377-1392.

[16] Szymański, P. 2017. Risk management in construction projects, Procedia Engineering, 208, pp 174-182.

[17] Thamhain, H. 2013. Managing risks in complex projects, Project Management Journal, 44(2), pp 20-35.

[18] Banaitiene, N. and Banaitis, A. 2012. Risk Management in Construction Projects. In: Risk Management-Current Issues and Challenges.

[19] Willumsen, P. Oehmen, J. Stingl, V. and Geraldi, J. 2019. Value creation through project risk management, International Journal of Project Management, 37(5), 731-749.

[20] Asaad, A. 2016. The effective project management process and risk management in infrastructure development projects in construction industry, Heriot-Watt University.

[21] Paslawski, J. 2013. Hybrid flexible approach for Six Sigma implementation in constructional SME, Journal of Civil Engineering and Management, 19(5), pp 718–727.

[22] Zhao, X. Hwang, B.G. and Low, S.P. 2013. Developing fuzzy enterprise risk management maturity model for construction firms, Journal of Construction Engineering and Management, 139(9), pp 1179–1189.

[23] Serpella, A. Ferrada, X. Rubio, L. and Arauzo, S. 2015. Evaluating risk management practices in constrction organisations, Procedia – Social and Behavioural Sciences, 194, pp 201-201.

[24] Goh, C.S., Abdul-Rahman, H. and Abdul Samad, Z. 2013. Applying risk management workshop for a public construction project: case study, Journal of Construction Engineering and Management, (139), pp 572–580.

[25] Zou, P.X.W. Chen, Y. and Chan, T.Y. 2010. Understanding and improving your risk management capability: assessment model for construction organisations, Journal of Construction Engineering and Management, 136(8), pp 854-863.

[26] Choudhry, R.M. and Iqbal, K. 2013. Identification of risk management system in construction industry in Pakistan, Journal of Management in Engineering, 29, pp. 42–49.

[27] Fan, M. Lin, N.P. and Sheu, C. 2008. Choosing a project risk-handling strategy: An analytical model, International Journal of Production Economics, 112, pp 700-713.

[28] Pimchangthong, D. and Boonjing, V. 2017. Effects of risk management practice on the success of IT projects, Procedia Engineering, 182, pp 579-586.

[29] Hwang, B.G., Zhao, X. and Toh, L.P. 2014. Risk management in small construction projects in Singapore: Status, barriers and impact, International Journal of Project Management, 32(1), 116-124.

[30] Yildiz, A.E. Dikmen, I. andBirgonul, M.T. 2014. Using expert opinion for risk assessment: a case stuy of a construction projct utilizing a risk mapping tool, Procedia – Social and behavioural Science, 119, pp 519-528.

[31] Oehmen, J. Olechowski, A, Kenly, C.R. and Ben-Daya, M. 2014. Analysis of the effect of risk management practices on the performance of new product development programmes, 34(8), pp 441-453.

[32] Besner, C. and Hobbs, B. 2012. The paradox of risk management: a project management practice perspective, International Journal of Managing Projects in Business, 5(2), pp 230-247.

[33] Gilge, C.L. 2013. Avoiding Major Project Failure- Turning Black Swans White, Whitepaper, KPMG LLP.

[34] Bertelsen, S. 2003. Complexity - Construction in a new perspective, Virginia.

[35] Ortega, I. 2000 Systematic prevention of construction failures: An overview, Technology, Law and Insurance, (1-2), pp 15-22.

[36] Leavy, P. 2017, Research Design: Quantitative, Qualitative, Mixed Methods, Sage Publication.

[37] Saunders, M.N.K. Lewis, P. and Thornhill, A. 2019. Research Methods for Business, 8th Edition, Pearson

[38] Rand Water. 2021. Rand Water Integrated Annual Report. Available at: http://www.randwater.co.za/Annual Reports.

Appendix A: Questionnaire

To what extent do you agree or disagree with each of the following. 1 = Strongly Disagree (SD); 5 = Strongly Agree (SA)

To establish the relationship between project risk management and projects success in water utility projects

	SD	D	N	A	SA
1. In our organisation, project risk management has impact in attaining project success.					
2. In our organisation, tools for managing knowledge on project risk management assist in attainment of project success.					
3. In our organisation, databases containing information on project risk management assist in attainment of project success.					
4. In our organisation, knowledge sharing on project risk management increases the chances of project success.					
5. In our organisation, client involvement in project risk management results in project success.					
6. Knowledge sharing on risk management in IT projects accelerates the relationship between project clients and project team.					

To establish how project failures can be mitigated in the construction industry's water utility projects

	SD	D	N	A	SA
7. In our organisation, project risk management practices assist in minimising project failures.					
8. In our organisation, information on project risks from previous projects is used to manage future projects.					
9. In our organisation, we respond to identified risks mitigation planning.					
10. In our organisation, we perform regular project team training n project risk management.					
11. In our organisation we hold meetings to review active, occurred or retired risks.					

To establish the impact of effective project risk management in the construction industry's water utility projects

	SD	D	N	A	SA
12. In our organisation, at the commencement of each project, a full project risk assessment is done.					
13. In our organisation, project risk management is practiced on every project.					
14. In our organisation, different tools and techniques are used to identify project risks.					
15. In our organisation, risk prioritisation is linked to project objectives.					
16. In our organisation, knowledge pertaining to project risk management is managed centrally.					
17. In our organisation, information on project risks is analysed to support the decision-making process during project implementation.					
18. In our organisation, project risk management on projects is done internally.					
19. In our organisation continuous communication on project risk management enable better project management.					