RISK GOVERNANCE IN THE SOUTH AFRICAN WATER SERVICES SECTOR:
BUSINESS VALUE CREATION & BEST PRACTICE

Andrew McDonald and Jessica Fell

WATER RESEARCH COMMISSION

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RISK GOVERNANCE IN THE SOUTH AFRICAN WATER SERVICES SECTOR: BUSINESS VALUE CREATION & BEST PRACTICE

Report to the
Water Research Commission

by

Andrew McDonald[1] and Jessica Fell[2]

[1]Arup (Pty) Ltd
[2]University of Cape Town

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WATER RESEARCH COMMISSION

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University of Cape Town • iYunivesithi yaseKapa • Universiteit van Kaapstad

Obtainable from
Water Research Commission
Private Bag X03
GEZINA, 0031

orders@wrc.org.za or download from www.wrc.org.za

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EXECUTIVE SUMMARY

The provision of water and sanitation services occurs within a constantly changing and interdependent social, economic, political and environmental context resulting in a complex set of risks, hazards and uncertainties. Consequently the management of risk is a fundamental requirement for the effective and efficient delivery of water and sanitation services. Historically, risk in water utilities has been managed through traditional linear approaches and usually focusing on operational risks including water quality and asset failure. Some risks are systemic, interconnected and a function of various complex processes and systems that extend beyond the immediate operating environment. Other risks are specific to the utility and the internal context. Such diverse risks call for a holistic approach that goes beyond the usual linear functions and in the last few years, particularly in international water sectors, a move towards more iterative frameworks of risk governance rather than just risk management is evident. Such frameworks adopt holistic processes that embed risk decision making in all levels of an organisation, across all functions and encourage collaborative stakeholder engagement. Risk governance includes a more strategic view of risk and the human and organisational factors; including accountability, collaboration, decision making, sharing of risk and reward, communication, leadership and organisational culture.

Risk management practices are undertaken in the South African water sector, however these are often just focused on operational activities related to water quality and quantity (such as the Blue Drop, Green Drop and No Drop programmes and water safety and wastewater risk abatement planning). There is limited literature on risk governance practices in the South African water sector or the level of risk governance maturity of water service authorities and water service providers. A number of water service authorities and water service providers are thought to be struggling to establish risk governance activities and to integrate them into wider business functions.

The aim of this study is to understand how a selection of water service authorities and water service providers undertake risk governance, and to identify what makes this work and the value this is adding. To achieve this aim, a standard approach to the collection of data was required. To this end a risk maturity benchmarking model was developed. The model consists of nine criteria (strategic planning, risk policy & framework, risk based decision making, project risk management, people & resources, organisational culture & leadership, knowledge management, business continuity & emergency preparedness and performance management), which were further split into 24 components. Each component was assessed through a semi-structured interview and scored against a five point maturity scale (ad-hoc, initial, managed, defined, optimised). The model was used to assess the risk maturity of 13 water sector organisations that had agreed to participate in this study out of 170 that were invited.

The overall average maturity of the organisations varied from 2.4 (initial) to 3.9 (managed) out of a possible score of five. The Water Boards and the metropolitan municipalities were observed to have a higher maturity level compared to the small municipalities or municipal entities. It was found that all organisations assessed undertake risk management primarily in the form of routine risk assessments, water safety and wastewater

risk abatement planning. Risk governance is more than just the assessment of risk however. Most organisations had established some risk governance practices and are moving towards a governance approach to risk at an enterprise level.

Ten of the organisations have an average maturity score of between two and three. This suggested they have recognised the need for and benefits of risk governance and established at least basic processes and procedures, possibly to meet regulatory requirements. In some cases these organisations have developed a managed approach that exceeds regulatory requirements and extends across core business areas. There is some documentation that details certain procedures, responsibilities, criteria and methods relating to risk management and basic audit mechanisms verify compliance. There is some cross-functional and external consultation and adequate resources in place. Organisations at this maturity level are still vulnerable to change and uncertainly and are still reactive in some management approaches. Furthermore the approaches used are generally still linear in application with risk being merely a product of the likelihood of an explicit event and its consequence. Iterative and holistic frameworks of risk governance rather than just risk management are not fully established.

Three organisations have an average maturity level between 3.4 and four. As organisations move from a maturity level of three to four they start to embed their risk management activities at an enterprise level with processes, procedures and systems in place to work across all functional boundaries providing an integrated response to events. At this level of maturity systems and performance metrics are in place to evaluate the effectiveness of the risk management system, data is actively used to improve business processes and provide assurance. Risk is considered holistically, key stakeholders are consulted and involved in decision making and a risk aware culture is becoming established.

Effective risk management and governance is a fundamental requirement for the safe and reliable provision of water services. In the complex, interconnected and globalised world of today, the water sector in South Africa can greatly benefit from an approach that offers value across every function of the organisation. Although all participating organisations had begun their journey to risk excellence, many still have considerable steps to take in order to achieve the full value from risk activities.

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Ms Ingrid Cawood	Umgeni Water
Mr Dan Naidoo	Umgeni Water
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Mr John Critchley	Rand Water
Mr Mduduzi Shabangu	City of Tshwane
Dr Jo Burgess	Water Research Commission
Dr Anthony Ceronio	CSV Water
Dr Ludwig Geldenhuys	City of Cape Town
Ms Bhavna Soni	eThekwini Municipality
Dr Marlene van de Merwe Botha	Water Group Holdings
Ms Nomvula Mofokeng	City of Johannesburg
Mr Derek Weston	Pegasys
Dr Kevin Winter	University of Cape Town
Mr Oliver Laloux	Mondial Risk and Business Consultants

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ACRONYMS & ABBREVIATIONS

CBA	Cost Benefit Analysis
CFAR	Cash Flow at Risk
CIRIA	Construction Industry Research and Information Association
CMA	Catchment Management Agency
CMM	Capability Maturity Model
COSO	Committee of Sponsoring Organizations of the Treadway Commission
DST	Decision Support Tool
ERM	Enterprise Risk Management
FMEA	Failure Mode and Effect Analysis
GIS	Geographical Information System
HACCP	Hazard Assessment and Critical Control Points
IDP	Integrated Development Plan
IRGC	International Risk Governance Council
IRM	Integrated Risk Management
IRMSA	Institute of Risk Management South Africa
ISO	International Standards Organisation
KPI	Key Performance Indicator
NGO	Non-Governmental Organisation
SANS	South African National Standard
SCADA	Supervisory Control and Data Acquisition
SDBIP	Service Delivery and Budget Implementation Plan
SHEQ	Safety, Health, Environment and Quality
SOP	Standard Operating Procedure
SWOT	Strengths, Weaknesses, Opportunities, Threats
UKWIR	United Kingdom Water Industry Research
WHO	World Health Organisation
WSA	Water Service Authority
WSDP	Water Services Development Plan
WSP	Water Service Provider
WSP	Water Safety Plan
WUA	Water User Association
WWRAP	Wastewater Risk Abatement Plan

GLOSSARY

- **Barrier** – a measure put in place to prevent a failure. These can be physical such as a sand filter or a sewer pipeline, or they can be softer for example training programmes, water quality monitoring, operator behaviour and vigilance.
- **Benchmarking** – The process of measuring, comparing and tracking organisational performance relative to a best practice standard or a comparison with best in class organisations.
- **Communicate & consult** – The two way and iterative process of gathering and sharing information between stakeholders relevant to the management of risks.
- **Consequence** – The impact of an event, activity or hazard on objectives. There are often a range of potential consequences from one event, activity or hazard, and these can be both positive and negative.
- **Control** – A measure that is established to modify a risk. Also called a risk response.
- **Corporate blindness** – When organisations continue to do things in the same way as before without realising that better ways of working are possible. This can cause organisations to be blind to new risks or result in old solutions being applied unsuccessfully to new problems.
- **Cost benefit analysis** – A methodology used to identify and quantify the total costs and benefits of an activity to inform decision making. Outputs that are cost effective will typically be favourable for implementation.
- **Culture** – The collective mind set, behaviours, values and beliefs that shape and influence actions, interactions and decisions.
- **Deterioration model** – A methodology that uses statistical analysis to predict when an asset might fail.
- **Establishing the context** – Identifying and defining the internal and external factors and parameters that could influence the way the organisation manages risk. This will also include defining the risk criteria.
- **Failure mode effect analysis** – Methodology to systematically identify the components of a system, how they may fail, the likelihood and consequence of failure.
- **Gateway process** – Decision making process to identify and assess the risks and benefits of a project at key points in the project lifecycle.
- **Hazard** – A source of potential harm.
- **Inherent risk** – Risk that exists before any risk response is in place.
- **Interdependencies** – Where risks are connected in some way or have an effect on each other.
- **Likelihood** – The probability or chance that the consequence or impact could occur.
- **Opportunity cost** – The cost of an alternative that must be forgone in order to pursue a certain action. Put another way, the benefits you could have received by taking an alternative action.
- **Proactive risk management** – When organisations actively manage risks by continuously anticipating future issues, preparing risk scenarios and plan to manage these. These types of organisations are more resilient to risk.
- **Reactive risk management** – When organisations are prone to deal with issues when they arise and place less focus on preventing future risks.
- **Reporting cycle** – The continuous process of capturing, reviewing, reporting and managing risks according to a defined schedule and programme. Each organisation will typically choose a cycle that meets their needs and may be weekly, monthly, quarterly, half yearly or annually. Different cycles may exist for different levels of the business.
- **Residual risk** – The level of risk remaining after a risk control or treatment has been implemented. Zero residual risk is not possible. The aim should be to reduce residual risk to within the risk appetite.
- **Risk** – The effect of uncertainty on objectives. The effect can be positive or negative.

- **Risk analysis** – The process of using quantitative or qualitative methods and tools to define the nature and level of a risk by assessing consequence and likelihood.
- **Risk appetite** – The upper and lower limits of acceptable risk exposure for a particular objective that the organisation is prepared to take. Risk appetite needs to be quantified, recorded and communicated.
- **Risk assessment** – The combination of risk identification, analysis and evaluation, whereby the level of risk posed to an objective is determined.
- **Risk attitude** – The overall approach to pursue, retain or manage risks in pursuit of objectives.
- **Risk champion** – An individual who is tasked with promoting risk management and governance within the organisation, usually within their team or department.
- **Risk coordinator** – An individual who is tasked with specific risk management responsibilities within their team or department.
- **Risk criteria** – Terms of reference against which the significance, likelihood and consequence of a risk is assessed. The criteria are based on organisational objectives, risk appetite and the organisational context.
- **Risk evaluation** – The process of comparing and prioritising risks and determining how these risks will be managed.
- **Risk governance** – The coordinated activities of an organisation to control risks, encompassing the risk management activities as well as the wider cultural, leadership, communication and corporate governance activities.
- **Risk identification** – The process of identifying potential hazards, events and activities that may result in a risk. Risk identification can involve historical observations, expert judgement, modelling, and forecasting and stakeholder engagement.
- **Risk management audit** – A systematic and independent process for evaluating the risk management system to ensure it is effective and fit for purpose.
- **Risk management framework** – Set of components that provides the foundation and arrangements for designing, implementing, monitoring, reviewing and improving risk management activities in the organisation.
- **Risk management plan** – A specific plan aligned to the risk management framework that specifies the actions to be undertaken and the resources required to implement the framework for a particular part of the organisation, for example a water safety plan, asset management plan or a project delivery plan.
- **Risk management policy** – A high level statement of intent outlining the support, mandate, commitment and direction of the Board or executive leadership to risk governance in the organisation.
- **Risk manager** – A key position in a water utility responsible for managing and coordinating the risk governance functions. This position needs to be at an enterprise level thereby providing a link between operational and programme risk management and the more strategic business activities of the Board or executive leadership. Sometimes the role can be called a chief risk officer.
- **Risk matrix** – A graphical grid display of likelihood and consequences scales used to show thresholds of low, medium and high risks. A risk matrix can be used to promote a discussion about the risks but must not be solely relied on to prioritise risks.
- **Risk register** – A record of organisational risks that satisfy the defined reporting criteria. The register can include various components that suit the organisational needs such as a description, likelihood, consequence, risk owner, controls and their effectiveness. The risk register is a living document that must be regularly reviewed and used to direct managerial effort.
- **Risk reporting** – Form of communication to stakeholders about the status of risks and their management. Reporting usually happens according to a reporting cycle. A well designed risk register can make risk reporting easier and simpler.
- **Risk response** – A measure that is established to modify a risk. Also called a control.

- **Risk treatment** – The process of designing and implementing a risk response, control or barrier using the outputs from the risk evaluation activity.
- **Stakeholder** – An organisation or person, including customers and the public, who have an interest in what the organisation does or are affected by decisions the organisation makes.
- **Strategic risks** – High level risks that could affect strategic organisational objectives. These often include business critical risks to reputation, financial viability, legislative compliance or strategic direction.
- **SWOT analysis** – A methodology to identify the strengths, weaknesses, opportunities and threats to a project or business objectives.
- **Vulnerability** – The property of something to be susceptible to harm or a source of a risk.
- **Wastewater risk abatement plan** – a structured methodology to identify hazards and risks in a waste water system adopting a source to source approach.
- **Water safety plan** – a structured methodology to identify hazards and risks in a water system adopting a source to tap approach.

CHAPTER 1: BACKGROUND

1.1 INTRODUCTION

South Africa is facing a number of acute and chronic socio-economic challenges such as access to services, skills and capability shortfalls, urbanisation, unemployment and a large gap in income status. These pose a serious threat to the safe, efficient and sustainable delivery of water and sanitation services. The provision of reliable water services involves a complex set of risks and risk interdependencies, multiple hazards and unpredictable characteristics of drinking and wastewater systems. Therefore a formalised capability in risk management is fast emerging in the water sector as a critical competency in delivering efficient water services in an ever changing local, regional and global environment (Pollard, 2014).

Historically, risk in water utilities has been managed through traditional linear approaches and usually focusing on operational risks including water quality and asset failure. Many risks are systemic, interconnected and a function of various complex processes and systems that extend beyond the immediate operating environment. Such diverse risks call for a holistic approach that goes beyond the usual linear functions and in the last few years, particularly in international water sectors, a move towards more iterative frameworks of risk governance rather than just risk management is evident. Such frameworks adopt holistic processes that embed risk decision making in all levels of an organisation, across all functions and encourage collaborative stakeholder engagement. Risk governance includes a more strategic view of risk and the human and organisational factors; including accountability, collaboration, decision making, sharing of risk and reward, communication, leadership and organisational culture

Risk management practices are undertaken in the South African water sector, however these are often just focused on operational activities related to water quality and quantity (such as the Blue Drop, Green Drop and No Drop programmes and water safety and wastewater risk abatement planning). There is limited literature on risk governance practices in the South African water sector or the level of risk governance maturity of water service authorities and water service providers. A number of water service authorities and water service providers are thought to be struggling to establish risk governance activities and to integrate them into wider business functions.

In response, Arup (Pty) Ltd and the University of Cape Town were commissioned by the Water Research Commission to undertake a study entitled Risk Governance in the South African Water Services Sector: Business Value Creation and Best Practice. The study investigated the nature and maturity of risk governance practices in a selection of water service authorities and water service providers. Furthermore the interaction between risk management activities (such as the identification of risks) and wider governance

activities (such as consultation, decision making, communication) was explored to identify where risk based approaches are used to inform decision making and to identify the value this can create.

1.2 PROJECT AIMS

The aims of the study were as follows:

1. Develop a comprehensive understanding of how risk is managed and governed in a wide range of water service sector stakeholders
2. Undertake a high level benchmarking activity of stakeholders to understand the level of maturity in risk governance
3. Identify strategic and tactical interventions that can be implemented to improve the way risk is managed
4. Identify business value creation benefits and strategic opportunities of integrating risk governance with other business processes

1.3 OUTLINE OF THE REPORT

Chapter 2 presents a review on existing literature on risk management and governance, with both a South African and international perspective. It presents key concepts and definitions and reviews water utility maturity and culture. Furthermore, it explores the value that a risk governance approach can add in various key business areas.

Chapter 3 describes the development of a risk maturity model. It presents a review of existing risk maturity models which were used to inform the risk maturity model for the South African water sector.

Chapter 4 describes the results from the risk maturity assessments. It presents the stakeholders participating in the assessment and the assessment methodology that was followed. It discusses the findings under the criteria described in the model.

Chapter 5 provides a conclusion and various recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

The significance of water cannot be overstated. Water resources remain one of the most critical issues for economic growth, the integrity of natural ecosystems and human societies that depend on them. Water is a strategic resource required for social and economic development and is a significant contributor to the transformation of South Africa (Department of Water Affairs, 2013). The cross cutting nature of water means it has a significant bearing on many facets of life and influences aspects as wide ranging as poverty, gender equality, education, climate resilience and health (Johnson *et al*., 1997; United Nations, 2012).

South Africa is a water stressed country with a low conversion of rainfall to runoff. Moreover rainfall patterns are variable across the country with significant differences in water availability in different areas (Turton & Patrick, 2005; Schreiner *et al*., 2009). The Limpopo, Inkomati, Pongola and Orange Rivers together drain approximately 60% of the country's land area. The water supplied by these rivers is of vital importance, supporting industries that contribute 70% of the gross domestic product and supporting about 70% of the population (Development Bank of Southern Africa, 2012). Water plays a central role in many sectors, particularly agriculture, mining and power generation. The agricultural sector accounts for 63% of water resource use in the country, whilst mining and bulk industrial water use is 17% (Department of Water Affairs, 2013). Furthermore the provision of good quality and reliable drinking water and the safe disposal of sewage is a fundamental requirement for healthy and sustainable communities, for maintaining public health and ensuring social cohesion.

2.2 CURRENT CONTEXT OF WATER SERVICES IN SOUTH AFRICA

Since 1994 new water legislation and policy has transformed the management of water resources by decentralising management through delegating to the lowest appropriate level (Funke *et al*., 2007). The National Water Act No. 36 of 1998 outlines the roles and responsibilities of the national department and advocates for public participation through various water resource management institutions such as catchment management agencies (CMAs) and water user associations (WUAs). The Water Services Act No. 108 of 1997 places the responsibility for the provision of water and sanitation services on water service authorities (WSAs), these being metropolitan, district and local municipalities. These services can be delegated to water service providers (WSPs), but the overall accountability still resides with the WSA. It also sets out the roles and responsibilities of Water Boards as bulk WSPs. Municipalities that are WSAs also provide a number of other services, which are regulated by the Municipal Systems Act No. 32 of 2000. Although municipalities govern themselves they are accountable to the national Department of Cooperative Governance and Traditional Affairs.

The decentralisation has resulted in a water sector with many stakeholders that have varying degrees of direct and indirect influence, including all three spheres of government, civil society, publicly owned entities, non-governmental organisations (NGOs) and the private sector. **Figure 2.1** shows the stakeholders that have been identified by the legislation and **Table 2.1** outlines the roles and responsibilities of each of these stakeholders. The full spectrum of stakeholders will be invited to participate in this study; however the benchmarking will focus specifically on the legislated stakeholders – the water service authorities, water service providers and water boards.

Figure 2.1: Relationship between water sector stakeholders

Table 2.1: Roles and responsibilities of water sector stakeholders

Water Institution	Responsibilities
Department of Water & Sanitation	National government department that provides a regulatory role, national & regional water resource management& the implementation of strategic programmes & initiatives.
Water Service Authorities (WSAs)	Municipalities responsible for the provision of water & sanitation services at a local level.
Water Service Providers (WSPs)	Organisations that provides water & sanitation services under contract to WSAs.
Municipal Entities	Municipal owned organisation that can be a WSP.
Water Boards	State owned entities responsible for providing bulk water & sanitation services to other water institutions such as WSAs, WSPs and Municipal Entities.
Catchment Management Agencies	Affiliation of stakeholders to enable effective management of water resources at a catchment level.
Water User Associations	Affiliation of stakeholders at a local level that have a common interest in water use and allocation.
Trans Caledon Tunnel Authority	State owned entity responsible for financing & implementing bulk water & sanitation infrastructure projects.
Water Research Commission	Coordinates water sector research.

Access to water is a basic human right and enshrined in the Constitution. Water legislation, regulations and policy seeks to redistribute water resources in a more equitable and sustainable way (Dent, 2012). The priorities of local and national water institutions reflect this agenda of redress and redistribution by prioritising the provision of water services to communities that previously did not have any access (Turton & Patrick, 2005; Meissner *et al*., 2013). South Africa has thus experienced a rapid growth of water and sanitation systems in response to the service delivery demands. For example in 1994, only 59% of South Africans had access to basic water services, this has since improved to 94.7% in 2013 (Department of Water Affairs, 2013). In some instances these systems do not meet the minimum standards in terms of quality and quantity. Furthermore, the management, operation and maintenance of some systems do not meet best practice. The rapid expansion of water services, in some instances, came at the expense of a good quality service. The reasons for this are complex and vary by location and some of these are described below.

South Africa is a developing country with complex and dynamic institutional, social, political, regulatory, economic and physical environments influenced by a multitude of stakeholders at various levels of time and scale (Rogers *et al*., 2000). There are significant disparities in socio-economic status across the country, with South Africa being widely cited as one of the most unequal societies in the world, with a Gini coefficient of 59.6 (Donnelly, 2014). The legacy of Apartheid has left high levels of unemployment, large disparities in

income and access to services and a reduced capacity of institutions to deliver these services. Rapid and uncontrolled urbanisation is occurring as people move from rural areas into cities and towns seeking better socio-economic opportunities. This puts additional pressure on the authorities in these towns and cities and erodes the availability of skills in the rural areas (Department of Cooperative Governance & Traditional Affairs, 2009).

These challenges are common to all sectors and facets of life in the country and the water sector is not immune to these issues. The large gap between income and the high levels of unemployment in the country result in many communities being unable to pay for water services. Many municipalities have an insufficient revenue base and a reduced capacity to generate income to fund the provision of water services. Such situations largely occur in smaller rural municipalities where poverty and unemployment are higher compared to metropolitan municipalities. Municipalities that cannot fund the provision of water services then depend on grants from national government (Hollingworth *et al*., 2011). Much of the grant money is often misused for operational purposes and challenges like corruption further compromise the situation (Auditor General, 2013).

The shortage of skills within the water sector and the ability to effectively manage and govern are also challenges and in some instances municipalities are not compliant with legislation, particularly the Municipal Finance Management Act No. 56 of 2003 (Auditor General, 2013). A 2009 study indicated that only 72% of municipal posts were filled and only 76% of posts were budgeted for. It further indicated that half the technical managers are under-qualified and there is a high management turnover with 25% of management posts being vacant for more than three months (Department of Cooperative Government & Traditional Affairs, 2009). Without the right skilled people in place, this affects the ability to plan, design, construct, operate and maintain water and sanitation infrastructure and has resulted in a lack of integration in the development of water resources and water services. In places there is a lack of effective planning for the provision of water and sanitation services and targets for providing these services are not always set.

All WSAs must develop a five-year Water Service Development Plan (WSDP) which must be updated on an ongoing basis, yet by 2013 the Department of Water and Sanitation had received only 140 draft or interim WSDPs and only 10 Council approved WSDPs. Two WSAs had not submitted any WSDP (Department of Water Affairs, 2013c). The WSDP forms the basis of the municipal wide Integrated Development Plan (IDP) and without a robust and approved WSDP in place, the water and sanitation infrastructure required will not be adequately planned or budgeted for. Furthermore few of the WSDPs use risk based and asset management based principles when identifying investment needs, indicating a lack of water sector specific asset management policies, life cycle management models and management capacity for executing asset management to an appropriate standard in all municipal locations (Stephenson *et al.*, 2001).

The sum of these challenges results in specific symptoms, which are outlined below and are described in detail in various reports (Department of Cooperative Governance & Traditional Affairs, 2009; South African Institute of Civil Engineers, 2011; Development Bank of Southern Africa, 2012; Department of Water Affairs, 2013):

1. Pollution of aquatic systems and water sources from poorly managed sewerage systems and waste water treatment plants
2. Poor water conservation and demand management across the entire water sector value chain, leading to high water losses
3. Deteriorating domestic water quality from poorly managed reticulation systems and water treatment plants
4. Water and sanitation backlogs

It must be noted that the challenges faced by the South Africa water sector are not unique to the South African context as they are experienced in other parts of the world, both in developed and developing countries. For example, rural communities in Canada and the United States of America face similar challenges of skills shortages, weak management capability and poor governance (Hrudey, 2011). Cunliffe *et al.* (2005) surveyed 2,000 small water systems in Australia and identified that the biggest constraint to effective management and control of water quality risks was the lack of operator resources and skills. Botswana is currently undergoing a major water sector reform that is changing the way water and sanitation services are provided in an attempt to address similar skills shortages and management capacity challenges in rural areas (Stockholm International Water Institute, 2012). More than 50% of all water service providers in Kenya are not viable, neglect their infrastructure and survive only on state subsidies, mainly due to failure of corporate governance, weak management capacity and a shortage of skills and revenue (Federal Ministry of Economic Cooperation & Development, 2012).

These country wide structural issues and the symptoms that arise are compromising the effective, efficient and sustainable provision of water services. In turn this impacts on the production of food and energy, the maintenance of public health, the development of the economy and the uplifting of society. A paradigm shift in the manner in which water is managed is now required, one that considers risk and opportunity in all facets of water management. Improved management and governance of risk within the water sector provides an opportunity to facilitate solutions to these challenges and ultimately to secure the efficient provision of water services in South Africa. The challenges and opportunities will require innovative and collaborative solutions across the entire water services sector; involving both public and private sector organisations as well as civil society. Moreover, a change in the water sector governance structures will be required to improve accountability and foster a shared responsibility and ownership of risks. Improved risk and asset management practices, informed by international standards and best practices, could provide the framework to help identify, priorities and drive the improvements and solutions required. Such risk and asset management approaches will consider risk and opportunity in all decision making and will unlock considerable benefit and value for all stakeholders across the entire water value chain.

2.3 DEFINITIONS OF RISK MANAGEMENT & GOVERNANCE

Risk management is the identification, assessment and prioritisation of risks, followed by the development and implementation of mitigation measures to minimise the impact of negative events, as well as to maximise the realisation of opportunities (Hubbard, 2009). The water sector includes diverse risks, multiple risk drivers and unpredictable characteristics of drinking and wastewater systems. Hence, risk management has long been a key function of water utilities. Risk management has traditionally focused on operational aspects of the business (Pollard, 2008). Historically, risk in water utilities was managed through traditional linear approaches, however this has changed and a move towards more iterative frameworks is evident. Such frameworks adopt holistic processes that embed risk decision making in all levels of an organisation and encourage collaborative stakeholder engagement (Pollard *et al*., 2004).

In an increasingly complex and interconnected environment, faced with the emerging challenges of globalisation, increased international cooperation, the rise of NGOs and the changing role of the private sector and civil society, a shift to risk governance, as opposed to risk management has occurred. It is being recognised that many risks are not simple and cannot be calculated as a linear function of probability and effects or restricted to numerically defined probability distributions alone. Many risks are systemic, interconnected and a function of various complex processes and systems that extend beyond the immediate operating environment. Such systemic risks call for a holistic approach that goes beyond the usual linear functions (Lindhe, 2010). It is in this context that the notion of risk governance emerged in the early 2000's as a new paradigm in opposition to the classical notions of risk management. Early publications pioneering the concept did not provide a definition, but the establishment of the International Risk Governance Council in 2003 and a White Paper on risk governance in 2005 firmly rooted the notion (van Asselt & Renn, 2011).

Risk governance is a complex term and now has many definitions in the literature. Traditionally risk governance was associated with corporate governance and the responsibility of boards to identify and manage strategic risk, often financial in nature (Tarantino, 2008). Some of the more common definitions define risk governance as the critical study of complex, interacting networks in which choices and decisions are made around risks. Another defines it as a set of normative principles which can inform all relevant actors of society how to deal responsibly with risks (van Asselt & Renn, 2011). The concept includes more than just operational risk management but extends to cultural, organisational, leadership, accountability, institutional, stakeholder, legal, environmental and financial aspects of a business and the way this is all integrated and coordinated (Pollard *et al*., 2004).

The distinction between management and governance is often a challenging one to make as these concepts are interrelated. Management is concerned with action – the implementation of actions according to decisions and rules. The concept relates to organisational structures, making and enforcing rules, establishing and using systems and tools. Governance is concerned with politics, relationships and interactions – it is about the sharing of responsibility and power amongst relevant stakeholders to determine strategy, policy, management rules and determine processes for implementing management decisions (van

Asselt & Renn, 2011). According to Sowman & Wynberg (2014) governance is concerned with interactions and processes that occur between a diverse group of actors, including non-state actors often with diverging interests, in the process of addressing issues and creating solutions. Governance is more inclusive of all stakeholders and advocates for interactions such as shared value and visions, joint planning and decision making, sharing of risk and reward, defining accountability and the design and operation of institutional arrangements to support governing activities (Jentoft, 2007). The concept of risk governance therefore applies to any complex multi-stakeholder environment and is gaining traction within the international water sector.

2.4 RISK GOVERNANCE FRAMEWORKS IN THE WATER SECTOR

In the same way as there are a many definitions of risk management and governance, there is an abundance of international frameworks, regulations and guidelines on the concepts. The section below explores some of the more commonly used frameworks and guidelines that are used in the international and South African water sectors.

Corporate governance refers to the structures, processes and decision making that direct and control an organisation at a strategic level. The understanding and management of risk is a central component of corporate governance and one of the main functions of a board (International Risk Governance Council, 2006). The King III Code of Governance is an internationally accepted code for improved corporate governance. Central to the code is the understanding of risk at an enterprise level and the transparent reporting and communicating of risk and its mitigation to all stakeholders. Importantly, the King III Code says the board should prevent risk management from becoming a series of activities that are detached from the realities of the business (King, 2009). This is one of the key challenges most organisations face when trying to integrate risk management activities. One of the more prominent risk management frameworks is the ISO31000 standard. It is an international standard that provides generic principles and guidelines on managing risks (AIRMIC & IRM, 2010). **Figure 2.2** shows the risk management process as defined by ISO31000.

Figure 2.2: ISO31000 risk management process (International Standards Organisation, 2009)

The ISO31000 standard identifies the following benefits of having a risk management system:

1. Increases the likelihood of achieving objectives
2. Encourages proactive management
3. Improves the identification of opportunities and threats
4. Complies with legal and regulatory requirements
5. Improves reporting and corporate governance
6. Improves stakeholder trust and confidence
7. Establishes a reliable basis for decision making
8. Effectively allocates resources
9. Improves operational effectiveness and efficiency
10. Enhances health and safety and environmental protection
11. Improves loss and incident management
12. Improves overall organisational resilience

The Committee of Sponsoring Organizations of the Treadway Commission (COSO) developed the Enterprise Risk Management (ERM) framework, which provides key principles and concepts, a common language, direction and guidance on risk practices at an enterprise level in an organisation. The underlying premise of ERM is that every organisation exists to provide value for its stakeholders. All organisations face uncertainty and the challenge for management is to determine how much uncertainty to accept as it strives to grow stakeholder value. Uncertainty presents both risk and opportunity, with the potential to erode or enhance value, and ERM enables management to effectively deal with this uncertainty and associated risk and opportunity, enhancing the capacity to build value (AIRMIC & IRM, 2010). The framework has since been incorporated into policy and regulation, and used by thousands of organisations to better understand risk and therefore control their activities to achieve their business objectives (COSO, 2004). Similarly the International Risk Governance Council (IRGC) has a framework that helps policy makers, regulators and risk managers to understand the concept of risk governance and apply it to their handling of risks at an enterprise level (Renn, 2005).

The ISO55000 asset management standard also has a risk component. The concept of risk and review is central to the asset management system. This approach needs to be applied to all asset related decision making throughout the life cycle of an asset and must be incorporated into all business procedures and processes that relate to the asset (International Standards Organisation, 2014).

The Drinking Water Quality Guidelines published by the World Health Organisation (WHO) advocates for a risk based approach to the way water systems are managed through the use of a Water Safety Plan (WSP). These require a comprehensive system wide risk assessment that encompasses all steps in water supply from catchment to consumer. The approach incorporates other risk management methodologies such as the multiple-barrier approach and hazard assessment and critical control points (HACCP) (Bartram *et al*., 2004). Many water sectors in countries around the world have used the international standards and guidelines to develop their own specific standards and guidelines. Australia has for many years led the way on risk

management approaches in their water sector and has published the Australian Drinking Water Guidelines and a Drinking Water Quality Management Framework, both documents following the same principles advocated in the WHO guidelines. These provide a consistent and clear methodology for all water utilities to follow when developing a WSP and implementing risk based monitoring and management systems (Miller *et al*., 2009).

The water sector in the United Kingdom has been undertaking asset related risk management practices for a number of years. In 2002 the United Kingdom Water Industry Research (UKWIR) published the Common Framework for Capital Maintenance Planning (UKWIR, 2002). This provided all water utilities with a common methodology to follow when developing capital investment plans. The methodology was based on risk of service failure and required water utilities to consider risk in all investment decision making. It was a seminal document that paved the way for a step change in the way water sector risks were considered and how these informed all water utility decision making. Both the Australian and United Kingdom water sectors have robust economic regulators that ensure the guidelines and frameworks are consistently implemented, which is something South Africa lacks.

These international frameworks have also influenced what is done in South Africa in regards to managing risks. Some concepts from the international frameworks are reflected in various South African legislation, frameworks and guidelines that pertain to risk management. In terms of legislation, both the Public Finance Management Act No. 1 of 1999 and the Municipal Finance Management Act No. 56 of 2003 state that the Accounting Officer is responsible for establishing and maintaining effective, efficient and transparent systems and internal controls for financial and risk management. These requirements usually are interpreted to relate to financial and fraud risks. Additionally the Disaster Management Act No. 57 of 2002 stipulates that local authorities need to appropriately plan for disasters through developing and implementing disaster risk management plans. The Occupational Health and Safety Act No. 85 of 1993 is concerned with risk to employee health and safety and requires employers to implement systems to manage these risks. The National Treasury has published the Public Sector Risk Management Framework and the Local Government Capital Asset Management Guidelines (National Treasury, 2008; 2010). Both of these documents provide a generic guide to national, provincial and local government for the implementation of asset and risk management strategies to allow them to meet the requirements of the legislation. The Institute of Risk Management South Africa (IRMSA) also provides risk management guidelines, which many South African organisations make use of.

Literature on risk management in the South African water sector is focused almost exclusively on sector wide water risks (CSIR, 2010; Department of Water & Sanitation, 2013), corporate water risk (National Business Initiative, 2014; Pegram & Eaglin, 2011; Amis & Nel, 2011), financial compliance risk (Auditor General, 2013), disaster risk management (Botha *et al*., 2010; Reid & van Niekerk, 2008), and operational risk management (Jack *et al*., 2011; 2011a). Several research studies have been undertaken to develop risk based tools and methodologies for various applications in the South African water sector. Disciplines where such tools and methodologies are being applied include water resource management (Casey & Meyer, 2006;

Scherman *et al*., 2004; Dennis *et al*., 2002), water quality management (Barnes & Taylor, 2004; Skivington, 1997) and ecosystem management (O'Brien *et al*., 2012. Claassen *et al*., 2001). When it comes to risk governance in water service authorities and water service providers, there are some gaps in the South African literature. Bhagwan (2009) describes some examples of where good asset management is undertaken, many of these examples draw on sound risk management and governance principles. In 2008 the Department of Water Affairs (now called the Department of Water & Sanitation) implemented the Blue and Green Drop programmes. The Blue Drop and Green Drop programmes are good examples of where a risk based approach to water service provision is advocated, and these programmes have resulted in much improvement in water quality in South Africa since their inception, for example in Drakenstein municipality (Water Information Network, 2012).

The Blue Drop programme is an incentive-based regulatory mechanism with the primary objective of safeguarding drinking water quality. The Green Drop programme follows a similar approach with the primary objective of improving wastewater effluent discharge quality (Department of Water Affairs, 2013a, 2013b). The No Drop programme introduced in 2013 aims to reduce the amounts of non-revenue water. All three of these programmes use risk based approaches. A significant component (35%) of the Blue Drop requirement is having a WSP in place (Department of Water Affairs, 2013a). Furthermore, the South African National Standard for Drinking Water SANS241 Part 1 and 2 (SANS, 2011) outlines the requirements for drinking water quality parameters, water quality risk assessment, risk based monitoring and WSPs. The Water Research Commission has developed a number of tools and a manual to aid practitioners to meet the water quality standards as required by SANS241 and the WHO requirements (Jack & de Souza, 2014; Thompson & Majan, 2009). Wastewater Risk Abatement Plans (WWRAP) are based on the same principles as a WSP and are applicable to wastewater systems (van der Merwe-Botha & Manus, 2011).

Since the Blue Drop programme has been in operation for a number of years, one would expect a high number of WSPs in place, however this is not the case. Only 13% of the systems audited in 2012 have active WSP processes, 52% of systems don't have any WSP activities in place and 62% of the systems have no full SANS241 or risk defined monitoring activities (Department of Water Affairs, 2013a). Municipalities without such risk based systems in place are increasingly at risk of water quality incidents.

2.5 THE NEED FOR RISK GOVERNANCE IN THE WATER SECTOR

The world and South Africa is undergoing considerable change. Political, economic and social systems are transforming in ways that are not always predictable, producing a variety of impacts. Technology is evolving and living standards, consumption patterns and life expectancies are all changing. Human populations are growing and increasingly moving to expanding urban areas while agriculture is expanding to feed them. Consequently, land use is altering, as is the climate. The long-term impacts of this change often remain uncertain (United Nations, 2012). Over the last few years, strategic business risks, with their root causes external to the water utility, have increased in importance (World Economic Forum, 2016). Consequently, the way in which water utilities assess and manage their business risks is changing. Now more than ever, water

resource managers, planners, users, and anyone who in any way impacts on the quantity, quality, distribution and use of water, must fully consider uncertainty, risk and opportunity in their decision making. A formalised capability in risk governance is fast emerging in the water sector as a critical competency in delivering efficient water services in an ever changing local, regional and global environment. In light of the various challenges facing the South African water sector, and in the context of change and uncertainty, the implementation of sound risk management and governance practices is critical to finding meaningful solutions that contribute to sustainable water management and improved service delivery.

Public sector organisations, such as water service authorities and water boards, are bound by their mandates to provide services in the interest of the public. None of these organisations have the luxury of operating in a risk free environment and the risk profile they have requires an extra duty of care on management to contain these risks to acceptable levels. Having a structured risk management system supported by sound risk governance is a valuable management tool that can increase the prospect of success through minimising negative outcomes and maximising opportunities (National Treasury, 2010). Managing risk within water utilities offers a myriad of benefits including customer, regulatory and investor trust, better operational performance, heightened emergency preparedness, better access to finance, more effective use of public and investor funds and greater employee engagement (Pollard, 2014).

Even though national government has recognised the importance of risk governance, in recent years there has been a number of instances that have highlighted a lack of robust risk governance capabilities in the South African water sector, illustrating the urgent need for a step change improvement. An example is the water contamination incident in Bloemhof in 2014, which affected over 500 people with diarrhoea and resulted in the death of three babies (South African Human Rights Commission, 2014; Gibbs, 2014). South Africa has a child mortality rate of over 70 per 1,000 births. A major cause of these deaths is diarrhoea, indicating the presence of high levels of pathogenic organisms such as bacteria and viruses in drinking water (Nannan *et al*., 2012). The frequency of such incidents does not come as a shock when one considers that 64% of waste water treatment works require urgent refurbishment, 14% are at a high risk of failure and 90% are not compliant in more than three effluent determinants (Department of Water Affairs, 2013). These statistics highlight the urgent water quality challenge faced by the water sector, and in particular water service authorities who use these contaminated resources to provide drinking water. Such a critical challenge could be addressed with improved risk management and governance practices in place.

Deteriorating water service caused 71 protests in 2012 (Department of Water Affairs, 2013). An example of such a failure is that in the community of Majakaneng, when violent service delivery protests broke out after years of an inconsistent water supply. In such a situation, if the risk of failing infrastructure had been effectively assessed and managed, the violent protests could have been avoided. Similar protests occurred in Mothutlung in 2013 where soldiers intervened to provide water after pump failures were blamed for taps running dry. Once again, sound risk management could have prevented the failure of the pumps either through regular maintenance or replacement. The examples described above illustrate the myriad of risks the water sector faces, in these examples major damage to reputation and customer trust. More so than

ever, the water sector requires risks to be effectively managed within a framework of good governance to secure the safe, reliable and cost efficient delivery of water services. If such risks are not effectively managed, there will be a continuation in the erosion of social cohesion, deterioration of public health and the constraining of social and economic development. The examples above also illustrate that the interpretation of the legislation and the application of the various guidelines varies widely throughout the municipal authorities in South Africa. Most metropolitan municipalities and water boards however, do have mature and effective risk management systems in place, and are going above and beyond the requirements of the legislation and guidelines. For example Umgeni Water and the City of Cape Town both have an Integrated Risk Management Framework that is aligned to ISO31000 and the King III corporate governance code of practice (Umgeni Water, 2012; McDonald & Geldenhuys, 2014) and Rand Water has an Enterprise Risk Management process that is also based on international best practice (Rand Water, 2010). Publically available information of the application of risk management and governance practices in other municipalities is lacking and hopefully this study will contribute to filling this gap in the literature.

2.6 CASE STUDY: RISK MANAGEMENT IN THE CITY OF CAPE TOWN

2.6.1 BACKGROUND TO THE CITY OF CAPE TOWN

The City of Cape Town is a metropolitan municipality located in the Western Cape Province of South Africa. **Table 2.2** shows some key statistics about the City and the water and sanitation assets (City of Cape Town, 2013).

Table 2.2: City of Cape Town key statistics

Households	1,068,572
Municipal Staff	28,000
Water & Sanitation Department Staff	4,000
Annual Operating Budget	R5.5billion
Annual Capital Budget	R1billion
Raw Water Reservoirs	12
Water Treatment Plants	13
Wastewater Treatment Plants	26
Water Pumping Stations	108
Sewage Pumping Stations	377
Water Pipeline	10,400km
Sewerage Pipeline	9,000km

The Water and Sanitation Department falls under the Utilities Directorate within the municipal management structure. The department is responsible for the operation, maintenance, optimisation, planning, refurbishment and renewal of all water and sanitation assets and in doing so provides an essential service to the residents and businesses of the City. **Figure 2.3** shows the management structure of the municipality.

Figure 2.3: shows the management structure of the municipality

2.6.2 INTEGRATED RISK MANAGEMENT FRAMEWORK

The City of Cape Town is committed to the optimal management of risks in order to achieve its vision and deliver its core business objectives. The City has adopted a consistent and joined up approach to the way risk is managed in the form of an Integrated Risk Management (IRM) framework (City of Cape Town, 2013a). The IRM framework is underpinned by the IRM Policy (City of Cape Town, 2013b). The primary objectives and outcomes of the IRM framework and policy are to:

1. Achieve a sustainable and reliable delivery of services
2. Enhance decision making by promoting a less risk adverse, innovative culture in which the taking of calculated risks in pursuit of opportunities is encouraged
3. Prevent redundancies, inconsistencies and gaps in City policies, procedures and guidelines
4. Provide for good corporate governance based on sound risk management principles
5. Minimise fraud and corruption
6. Improve performance and outputs through better project and programme management
7. Achieve better value for money through the more efficient use of scarce resources
8. Decrease surprises by understanding emerging risks and uncertainty
9. Prevent reputational damage
10. Ensuring compliance with legislation, regulations and corporate governance requirements

The framework has been developed by the IRM team that is led by the City Chief Risk Officer. The framework has been influenced by and meets the requirements of a variety of documents including:

1. The Local Government Municipal Finance Management Act No. 56 of 2003
2. The Local Government Municipal Systems Act No. 32 of 2000
3. National Treasury Public Sector Risk Management Framework
4. The King III Code of Governance in South Africa
5. ISO31000
6. ISO9001
7. Occupational Health and Safety Act No. 85 of 1993

Consequently, the City is going above and beyond their legislated responsibilities for risk management. This was recognised in 2010 by the Institute of Risk Management when the City was presented with an award for best in class risk management. This was followed in 2014 when the City was named top municipality in the African Utility Week awards, mainly due to its excellent infrastructure planning for short-term, medium-term and long-term service delivery. A key factor that allows them to plan effectively is having an IRM framework and policy in place.

2.6.3 OVERSIGHT, ASSURANCE & RESPONSIBILITIES

For the IRM framework to be successful it requires a clear definition of who is responsible for what. Various people and committees in the City are responsible for risk management oversight and assurance. **Table 2.3** shows these responsibilities.

Table 2.3: Risk management responsibilities

Name	Responsibility
Council	Provides the interface with the public. Provides the necessary challenges, checks and balances.
Audit Committee	Provides independent oversight on City governance, controls and the IRM policy and framework.
Risk Management Committee	Reviews risk management progress and maturity Assesses the effectiveness of risk management. Reviews key risks that have been identified.
City Manager	Ultimately accountable for all risk management in the City. Ensures the IRM policy, framework, procedures and guidelines are implemented in all departments. Develops and embeds a risk awareness and control culture in the City.
Senior Managers	Ensures the IRM policy, framework, procedures and guidelines are implemented in their departments. Accountable for risks in their departments. Ensures appropriate controls are in place to manage the risks. Ensures appropriate reporting is in place.

Name	Responsibility
Risk Champions and Coordinators	Officials in each department responsible for embedding the IRM policy, framework, processes and guidelines. Undertakes communication and training. Updates and manages the departmental risk registers. Ensures risks are discussed at monthly departmental meetings.
Officials	Undertakes the IRM activities and tasks according to the policy, framework, procedures and guidelines. Routinely identifies, assesses, controls and reviews risks. Provides feedback to Senior Managers, Risk Champions and Coordinators about issues, new risks and significant changes.
Internal Audit	Provides independent review on City governance, controls and the IRM policy and framework. Checks, tests and evaluates the effectiveness of risk management.
External Audit (Auditor General of South Africa)	Identifies weaknesses and non-compliances with required legislation, regulations and national standards.

The wide range of risk stakeholders, from elected council members and senior management right down to operational staff, and the clear reporting lines and accountabilities, suggests that risk management and to some extent risk governance is established within the City. Furthermore, internal business processes are in place that allow for effective risk decision making, escalation and delegation between all the people and committees with risk responsibility. **Figure 2.4** shows the relationship between stakeholders.

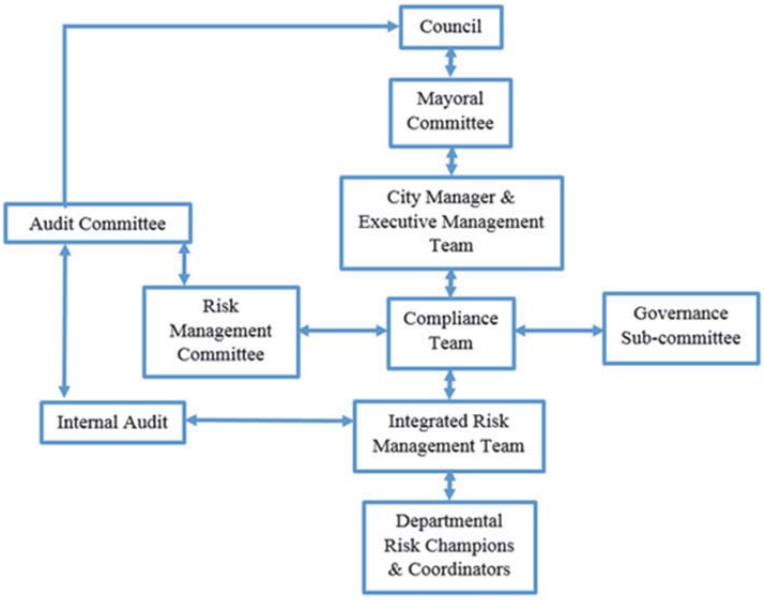


Figure 2.4: Relationship between stakeholders

The risk process is aligned to ISO31000 and consists of the following core components:

1. External Context – Defines the external environment affecting risk management including social, technological, economic, environmental, legislative, political, stakeholder, financial and global drivers and influences
2. Internal Context – Sets the roles, responsibilities and timescales for each stakeholder group. Defines the internal parameters, criteria and methodology used to undertake risk management
3. Communication and Consultation – External and internal consultation at all stages of the process to ensure the needs of all stakeholders are accounted for and to ensure a cross functional approach to risk management
4. Risk Identification – Activities, tasks, tools and systems that identify future uncertain events from both internal and external sources
5. Risk Analysis – Controls in place to manage the identified events and risks including preventative, detective and corrective controls
6. Risk Evaluation – Likelihood and impact matrix for determining risk rating
7. Risk Treatment – Identification of responses for each root cause to the risks that are above the City risk tolerance threshold
8. Monitoring and review – On-going monitoring of the risk register risks, controls and responses. Periodic review of procedures, risk matrix and tolerance thresholds. Production of dashboards and heat maps identifying new risks, critical risks and their movement

Risks are routinely identified, analysed and evaluated within each department and within each branch of each department. Each department will have its own systems in place to identify risks. The Water and Sanitation Department uses various decision support tools, SCADA data, maintenance work order data, asset condition and performance assessments and operational experience and knowledge to monitor trends, understand the assets and processes and identify issues and risks. In addition, most water treatment plants have WSPs and wastewater treatment plants have WWRAPs which identify risks to water and effluent quality. The identified risks are entered onto the Risk Management System (a software programme called Barn Owl); and the necessary treatment and reporting is implemented as defined by the IRM guidelines.

2.6.4 ENABLERS & BARRIERS

The primary enablers that have contributed to the success of the IRM are as follows:

1. Leadership and support from the highest level within the City management structure
2. Policy documents that reflect the need for integrated risk management and provide the framework for such systems to be implemented
3. Embedded systems that are simple to follow, auditable and integrated
4. Various departments including the Water and Sanitation department have ISO9001 accreditation which contributes to better governance and quality control
5. Cross functional working between teams and departments; where this does happen it has considerable benefits

6. Risk champions and coordinators in each department that communicate and manage risk processes on a daily basis

The primary barriers to improvement are as follows:

1. Silo thinking between teams and departments
2. Some departments are more mature in their adoption and implementation of the IRM processes which results in some inconsistencies
3. The success of the IRM system is heavily dependent on the initial identification of the risks, which in turn requires the correct internal departmental tools and systems to be in place and used correctly. Some departments have better tools, systems and capabilities than others
4. Risk management can become a “tick the box” exercise particularly if the local team cannot see the benefit to their day job
5. The Water and Sanitation Department collects a significant amount of data about assets and processes, which can be used to generate information and knowledge about current and future risks. Without an end-to-end asset information management system in place the true value of the data is lost and asset decision making is not optimised. The City has recently installed a SAP based finance and asset information system, which should improve the situation if it has been designed and implemented appropriately

2.6.5 CONCLUSION

The City of Cape Town has a robust system in place to manage risk across the entire municipal organisation. There is also some evidence to suggest risk governance processes are in place. The Water and Sanitation department are using the risk management framework to understand asset and process risk and therefore make asset related decisions that allow continued service delivery performance. What is unclear is the wider, strategic benefits and value creation that this brings; and the integration of risks within other directorates that seem remote from the direct operations of the Water and Sanitation department; for example disaster risk management, transport or spatial and environmental planning. It’s also not clear as to how risk informs whole life costing and the prioritisation of schemes in the WSDP or the IDP.

2.7 WATER UTILITY LEADERSHIP & CULTURE

Organisational culture is important as it acts as a filter to the uptake of new practices and influences how organisations function in regards to adaptation to change, resilience to shocks, knowledge management, stakeholder engagement and leadership (Summerill *et al*., 2010a; Alvesson, 2002). Schein (2004) defines organisational culture as a set of shared beliefs, values, assumptions, experiences and philosophies developed in learning to cope with problems of external adaptation and internal integration. Our response to risk is influenced primarily by cultural factors like personal interactions, education, identity and values. Furthermore risk decision making draws on both the analytical and emotional parts of our brains. In many cases we make decisions intuitively – we use rules of thumb, based on previous experiences reinforced by

our personnel networks. As a result there is a large variation on tolerance to risk between people, cultures and countries (Pollard, 2009).

Nonetheless, the protection of public health and the environment need to be priorities, irrespective of your view or tolerance of risk. The influence of culture on risk management is well documented in the international literature (Johnson, 1992; Drew & Kendrick, 2005). Drew & Kendrik (2005) outline culture as one of five pillars of corporate governance that are needed for integrated risk management. However, the influence of organisational culture on risk performance in the water sector has only been partially explored (Allan *et al*., 2013; Summerill *et al*., 2010, 2010a). Water utilities are often characterised as slow to respond to change, set in their ways and reluctant to innovate. Achieving sound risk governance may require a fundamental cultural change that involves changing the existing attitudes and behaviours of employees, management and external stakeholders. An organisations capacity to change its culture is influenced by many factors (Herrick *et al*., 2013):

1. Leadership style and issue inclination
2. Organisational structure
3. Learning mechanisms
4. Staff motivation
5. Management information system capacity
6. Technical capacity
7. Human resources practices
8. Budgetary and financial models and systems
9. Funding
10. Stakeholder and customer receptivity
11. Policy and legal environment
12. Regulatory restrictions

Best in class organisations are mindful about risks to their operations and consequently securing mindfulness is key for successful risk governance. Various approaches contribute to creating a mindful organisation such as the establishment of an effective reporting culture, integration and cooperation among departments and the open and transparent sharing of information. In a mindful organisation, everyone is a risk manager and everyone considers risk and its root causes in all they do. Such behaviour is embedded into business activities, reporting systems and performance management (Weick & Sutcliffe, 2006). Hrurdey *et al.* (2006) identified a number of key factors that water utilities can adopt when developing mindfulness and a strong risk culture, including:

1. Informed vigilance actively promoted and rewarded
2. Developing an in-depth understanding of the entire system, its challenges and limitations
3. Operational personnel are afforded the status, training and remuneration commensurate with their responsibilities as guardians of the public's health
4. Continual learning from past events and incidents and allowing the open and honest sharing of information

5. Local champions embedded in each team that communicate and coordinate risk related activities and ensure that risk is a part of everything everyone does

Leadership can be defined as the process of influencing others to understand and agree about what needs to be done and how to do it; and the process of facilitating individual and collective efforts to accomplish shared objectives (Summerill *et al.*, 2010). Good leadership is instrumental in creating a mindful culture that supports sound risk governance, as leaders have the power to influence aspects of organisational culture across the entire organisation and effect the necessary change (Tolbert & Zucker, 1996; Schein, 2004; Reason, 1998; Kotter, 1990). In addition, leadership influences the risks an organisation is willing to take, the direction the organisation will follow to meet its business objectives and the performance characteristics of the organisation (Allan *et al*., 2013). While the specific attributes of leadership that promote cultural change are not easy to predict and vary in different contexts, the literature highlights the importance of the following factors (Herrick *et al.*, 2013; Kotter, 1990):

1. Ability to establish a vision and direction and communicate this effectively
2. Aligning, motivating and inspiring people to achieve the vision
3. Ability to strategically problem solve
4. Ability to embrace a reflective and adaptive style of decision making
5. Ability to frame a narrative that tells a story about the importance of risk practices and related organisational changes in a language that a broad range of stakeholders can understand
6. Has a participatory rather than directive style
7. Ability to allocate resources appropriately

Previously, the management of risks in water utilities relied on the ability to predict extremes and limit their impact with technical means. In this paradigm, belief systems, human attitudes and collective behaviours are perceived as external boundary conditions and not as integral parts of management (Pahl-Wostl *et al*., 2007). Thus management that aims to embed a risk culture needs to adopt holistic approaches that take a range of trade-offs into account and involve stakeholders across the whole management process. Management needs to involve collaborative decision-making, management of problem sources not effects, flexible management approaches and iterative learning cycles (Herrick *et al.*, 2013; Pahl-Wostl *et al.*, 2007). The active and regular demonstration of management's commitment to risk practices has been shown as being imperative in generating commitment from other employees to drive a risk culture (Summerill *et al.*, 2010).

The way an organisation is structured in terms of ownership and legal entity fundamentally affects the way they manage and govern risk and the way they evolve and mature. Privately owned water utilities are owned by shareholders and therefore profit and shareholder return influence decision making. In many countries where private organisations provide water services, there is an economic regulator. As such, risk is often a consideration in decision making as it is a requirement for shareholders and regulators, will drive efficiency and profit and improve customer satisfaction. State owned enterprises, like water boards in South Africa, are run along the lines of private organisations, with the government as the only shareholder. The provision of

water services is the only function of the organisation. They have specialist management and a dedicated board of directors. There is less political interference, although being a shareholder, the government can direct strategic initiatives. Municipalities that provide water services perform many other functions, and the service of water is often only a small part of their wider responsibilities. Management is non-specialist and there is a non-specialist executive and council. Importantly there is an extensive political interface and decision making is not always based on sound risk and asset management principles as other factors need to be considered. The ownership and legal entity of an organisation is a key factor to consider when trying to understand how they are governed and the potential for evolution.

2.8 THE JOURNEY TO RISK GOVERNANCE EXCELLENCE

The journey to risk governance excellence can be represented by five maturity levels as described by MacGillivray *et al.* (2007). This journey can be seen as the progression from one maturity level to the next, as the institution develops the qualities and capabilities necessary to mature. While the journey will be specific to the organisational context, **Table 2.4** shows some of the qualities and activities needed to mature from one level of risk governance to the next.

Table 2.4: Maturity level characteristics (MacGillivray et al., 2007)

Maturity Level	Characteristics
Level 5 – optimised	The process is a continual, explicit component of organisational activities, forming part of the culture. Feedback is actively used to improve both the philosophy and execution of the process, and the adaptation of organisational structures and practices to optimise its ability to undertake the process (double loop learning). Management continually establishes measurable targets for process improvement, with systems in place to verify their achievement and to validate the means through which they are pursued. Active innovation, development and piloting of new ideas and technologies to optimise the process.
Level 4 – controlled	Verification mechanisms extend to provide quality assurance, and are supplemented by the capacity for process validation. Feedback is actively used to improve process execution, albeit within the constraints of existing process strategies (single loop learning). Broadly spread competencies enable the process to reside within affected disciplines, although stakeholders work together to achieve an integrated approach, capitalising on synergies and collective knowledge. Sufficient resources are available, with limited internal research & development.
Level 3 – defined	Process scope exceeds regulatory requirements, extending across core business areas. Documentation details procedures, criteria, methods and guidelines for process undertaking, whilst basic audit mechanisms verify compliance. Feedback limitations restrict process evolution to learning from 'events' (open loop learning). Processes reside within the responsible unit, with limited cross-functional or external consultation. Adequate resources in place.
Level 2 – repeatable	Basic process in place, focused on meeting regulatory requirements and addressing mission-critical risks. Initiated reactively, often in response to an event or situation. Limited capacity to evolve based on experience.
Level 1 – initial	No formal process; ad-hoc approach. Reliance on individual heroics. Limited awareness of regulatory requirements or relevant standards.

The journey to excellence is a long one and can take up to 15 years get from level 1 to level 5 (Pollard, 2014a). Reaching the ultimate goal of risk governance excellence involves multiple steps that require a considerable commitment and a diverse range of resources and capabilities. **Figure 2.5** is a graphical representation of the journey to risk management excellence, illustrating the cultural factors and key capabilities associated with each maturity level. The discussion below explores some of the key competencies, resources and processes identified as necessary when implementing an effective risk management system.

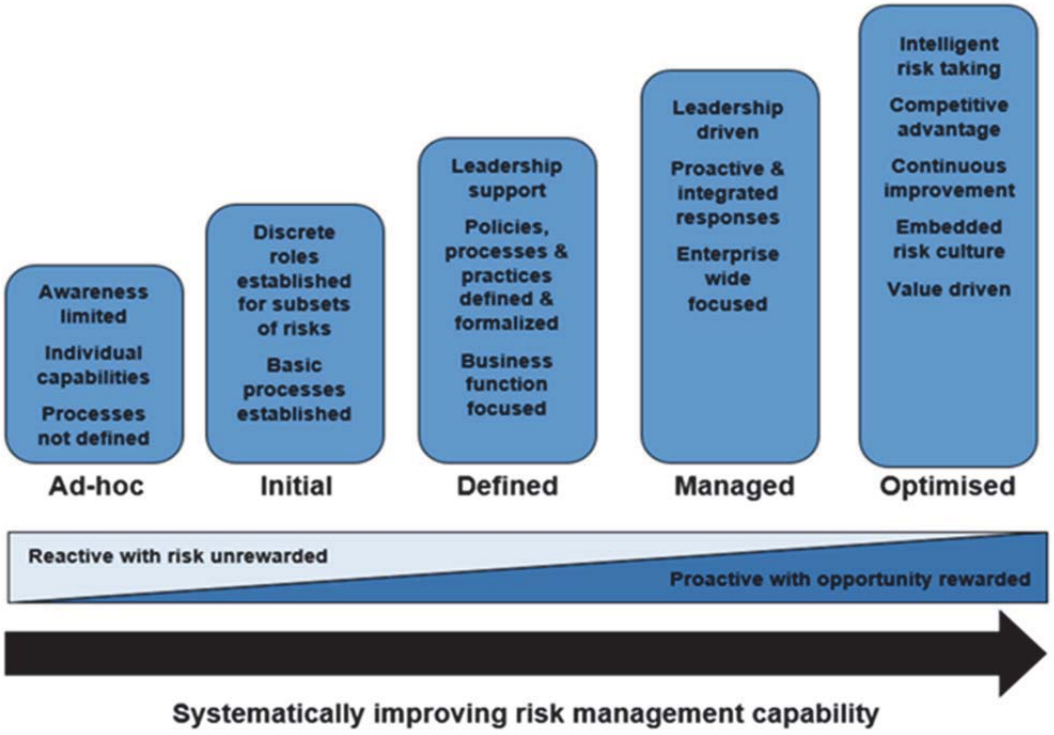


Figure 2.5: The journey to risk management excellence (Pollard, 2014)

The literature identifies various enablers and barriers to the successful implementation of risk management and governance within an organisation (Table 2.5). First and foremost, the journey to risk excellence requires leadership, a clear vision and an implementation plan. Over time, a step by step improvement can be made that will result in more integrated and robust processes, effective knowledge management and an embedded risk culture across every sphere of the organisation. Initially there must be an awareness of the value and benefits that risk management can provide and this needs to be communicated to all staff (Perrier *et al*., 2014; Summerill *et al*., 2011).

Risk management is a service to decision makers and must be seen as central to all activities rather than an additional activity. Successful risk management requires the whole organisation, and in particular executive management, to be advocates of risk. Management must be enthusiastic and committed to support the process and provide the necessary resources whilst implementing the implementation plan. Continuity of this support is vital and if management changes whilst on the journey, it is important to ensure the improvements and momentum achieved are not lost. Staff equally needs to display high levels of commitment to risk management. This means the involvement, recognition and empowerment of staff to successfully implement risk management (Perrier *et al*., 2014; Summerill *et al*., 2011). The move towards excellence requires organisations to act in a transparent, accountable and professional manner and for the interests of the customer to be held in the highest regard. This entails the effective engagement with internal and external stakeholders. Additionally, there must be a continuous improvement culture within the organisation, one that

wants to learn from mistakes and past events, be prepared to learn from others and is committed to professional development, training and education of staff (Parker & Summerill, 2013).

Table 2.5: Summary of enablers and blockers

Enabler	Barrier
Leadership support and commitment	Lack of leadership or no support
Risk management policy supported by management	No policy, a poorly drafted policy or a policy that is not actively supported and implemented
Risk management framework and implementation plan	No framework, a poorly drafted framework or a framework that is not actively supported and implemented
Sound corporate governance structures	No or poor corporate governance structures
Regular communication with all stakeholders	Silo thinking with limited communication
Enterprise wide risk manager	Silo thinking with limited collaboration
Risk champions and coordinators in teams with defined responsibilities	No or poorly defined risk roles
Defined and embedded decision making processes and procedures	No or poorly defined processes and procedures

Barriers to the successful implementation of a risk management and governance approach include a lack of awareness and uncertainty over how to implement risk management practices. Even with all the international and local standards, frameworks and guidelines, the interpretation of these can be challenging particularly for organisations without capability in the field of risk. Similarly, a lack of formal recognition for staff taking responsibility for risk management and implementing practices contributes to the reluctance of staff to become involved (Summerill *et al*., 2010). Poor internal communication hinders cooperation and cross functional working. Risk management is often undertaken in silos and not across an organisation at an enterprise level (Summerill *et al*., 2011). It is important to prevent risk management becoming a tick the box activity or something to be done for compliance purposes only. Another major blocker to risk management is the competing priorities in organisations; other business functions are often seen as more important than risk management. Lastly, implementing risk management requires a considerable amount of time and dedication and many organisations have a perceived lack of time and resources to implement risk management (MacGillivray *et al*., 2007). The real value of risk management is when it is undertaken at an enterprise level, fully integrated into all decision making and therefore supports business processes. When done well this can free up time and resources, improve communication, break down silo working and drive real value in the organisation. The table below summarises the enablers and blockers.

These enablers and barriers need to be considered within the context of the challenges in the South Africa water sector. For example the lack of capacity and funds in some of the small municipalities may make the implementation of risk management and governance challenging. Existing staff are often focused on solving

immediate and often urgent day-to-day problems and there is limited capacity to undertake risk management at a strategic level. In cases like this, a clear step by step plan is required that can make small improvements over time. In many cases having a strategic view of risk may well lead to improvements over time as the organisation slowly starts to become more proactive rather than reactive.

2.9 INTEGRATING RISK WITH OTHER BUSINESS FUNCTIONS

The water sector value chain is complex and interconnected. Moreover the sector is subject to the influences of a global and regional economy. This is driving the need for integrated risk governance practices that considers risk holistically, both at a sector level and within an organisation. The true value of risk governance is only realised when it is integrated with other business functions and considers risks beyond the operational aspects of the business. Well-established and mature risk management capabilities can be used to support other strategic functions and in doing so drive real value (Pollard, 2014). The sections below describe some examples in international and the South African water sector, of where risk management and governance approaches have been integrated into other business functions.

2.9.1 STRATEGIC PLANNING

All organisations need to undertake strategic planning and water utilities are no different. In many water utilities risks are frequently considered at an operational level and over short time frames; and are not routinely considered at a strategic level and over longer timeframes. Due to the nature of the water utility business, strategic risk assessments and planning is critical, with horizons typically between 10 and 25 years. There are many approaches used to identify future risks for strategic planning, such as SWOT analysis (strengths, weaknesses, opportunities and threats) and horizon scanning. Horizon scanning uses a combination of methods, including workshops and stakeholder engagement, to take a baseline risk profile and forecast how it may change under various future scenarios. Sydney Water in Australia used this approach to identify four plausible future scenarios, what the main risks would be in each scenario and how these would impact the strategic objectives of the business (Sydney Water, 2014).

An emerging approach is risk futures analysis. A methodology is described by Luis *et al.* (2012), which has been used by the EPAL water company in Portugal. A baseline level of risk was established through both a bottom up and top down identification of casual factors, impacts and probabilities. The interactions between the risks were mapped on an influence diagram and the outputs were tested against future scenarios including water scarcity, financial resource scarcity and strong economic growth. By linking risk and futures this approach can challenge the conventional way of risk assessment, build trust amongst the stakeholders and generated knowledge that could be shared easily with both the board and operational personnel (Koivisto *et al*., 2009). The understanding of long term financial factors such as revenue, costs and cash flow is also important when undertaking long term planning. This is especially relevant when determining tariffs or bills. The cash flow at risk (CFAR) approach is widely used in the industrial sector. This analytical method uses historic data to model the uncertainty of cash flow. Using a multivariate regression analysis the

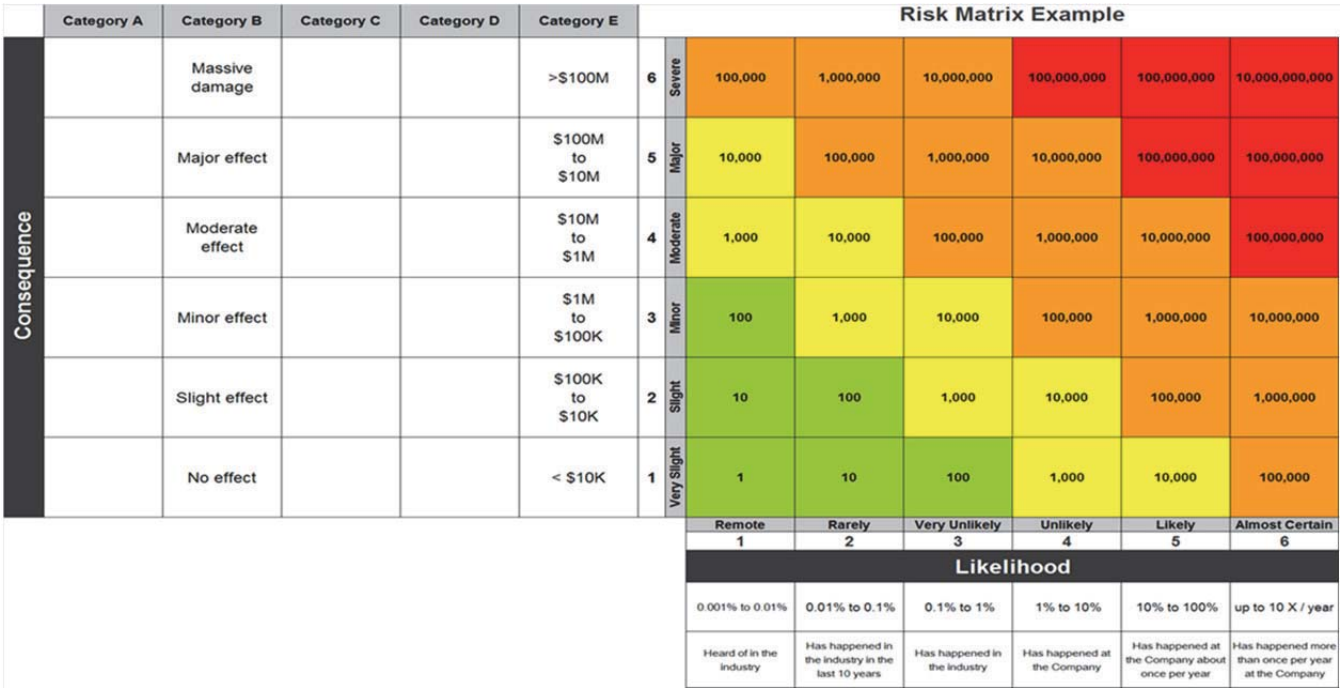
correlation between historic cash flow and factors that affect cash flow is calculated. A Monte Carlo simulation then gives a distribution of predicted future cash flows from which a CFAR value can be selected. Such an approach could be very powerful when undertaking long term strategic planning, setting tariffs or determining the impact of macroeconomic changes. This could allow a more robust assessment of a water utilities financial resilience under future scenarios (Andren *et al*., 2005).

Kirkpatrick (2009) recognises that integrating the strategic perspectives of risk into the day to day operational activities is challenging, and many organisations fail to do so successfully. Moreover, when organisations fail in most cases it's a lack of suitable corporate governance procedures rather than the inadequacy of risk management systems alone. For example information about risk exposures may have been correctly identified through the risk management system, yet not communicated to the board or senior management. Often risk management is an activity rather than enterprise based. A key factor to enable such integration to occur is for the board and senior leadership to establish the risk culture, values and ethics of the organisation, set the correct tone from the top and lead by example. Such behaviour needs to be underpinned by a risk policy that is consistently communicated and implemented (Financial Reporting Council, 2014). Line of site between operational risk assessment activities all the way up to corporate and strategic objectives and outcomes is required, and therefore strategic outcomes and objectives must be identified first (International Standards Organisation, 2009).

2.9.2 TACTICAL PLANNING

Tactical planning includes operational planning and investment planning undertaken over short to medium term horizons, typically annually to five yearly. There are many tools and methodologies used in tactical planning to identify, understand and manage risk in water sectors around the world (Pollard, 2008). Some of these approaches are simple and use traditional risk assessment methodologies including system characterisation, hazard identification, exposure assessment, control evaluation, consequence evaluation and likelihood evaluation. The outputs of this assessment are displayed in a matrix format and are often qualitative or semi qualitative (Pollard *et al*., 2004). **Figure 2.6** shows an example of a risk matrix used by the EPCOR water company in Canada.

The ISO55000 asset management standard (International Standards Organisation, 2014) and the Common Framework for Capital Maintenance Planning (UKWIR, 2002) both stipulate that life cycle decision making needs to be based on an assessment of risk. Such assessments also need to consider cost and performance in an integrated manner. There are many tools and methodologies that water utilities use to apply this, including deterioration models, risk analytic models, cost benefit analysis and whole life costing. Before such tools and methodologies are used, a risk framework needs to be defined, that sets the criteria, parameters and decision making structure (International Standards Organisation, 2009). The framework can then be used to develop operational, maintenance and investment plans. McDonald (2014) describes such a framework implemented by a water utility in the United Kingdom. **Figure 2.7** shows the process flow followed from initial risk identification through to solution implementation.



	Category A	Category B	Category C	Category D	Category E			Risk Matrix Example					
Consequence		Massive damage			>$100M	6	Severe	100,000	1,000,000	10,000,000	100,000,000	100,000,000	10,000,000,000
		Major effect			$100M to $10M	5	Major	10,000	100,000	1,000,000	10,000,000	100,000,000	100,000,000
		Moderate effect			$10M to $1M	4	Moderate	1,000	10,000	100,000	1,000,000	10,000,000	100,000,000
		Minor effect			$1M to $100K	3	Minor	100	1,000	10,000	100,000	1,000,000	10,000,000
		Slight effect			$100K to $10K	2	Slight	10	100	1,000	10,000	100,000	1,000,000
		No effect			< $10K	1	Very Slight	1	10	100	1,000	10,000	100,000
								Remote	Rarely	Very Unlikely	Unlikely	Likely	Almost Certain
								1	2	3	4	5	6
								Likelihood					
								0.001% to 0.01%	0.01% to 0.1%	0.1% to 1%	1% to 10%	10% to 100%	up to 10 X / year
								Heard of in the industry	Has happened in the industry in the last 10 years	Has happened in the industry	Has happened at the Company	Has happened at the Company about once per year	Has happened more than once per year at the Company

Figure 2.6: Risk matrix (Smigarowski & Cudrak, 2014)

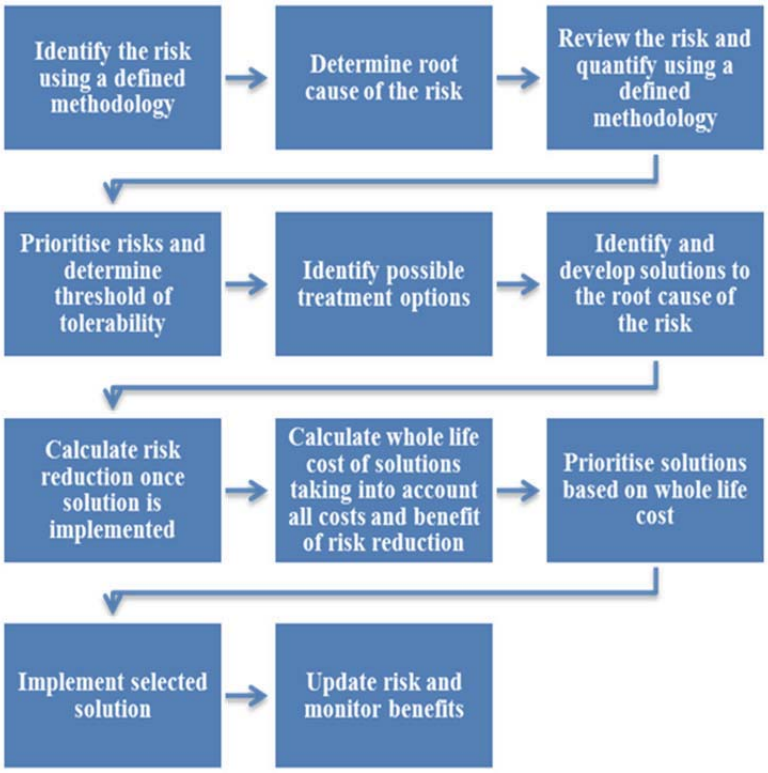


Figure 2.7: Risk based decision making process flow in tactical planning (McDonald, 2014)

2.9.3 COST

To make risk ratings more relevant to business decision making, a consideration of cost is required, through a cost benefit analysis (CBA) approach. The use of qualitative or semi-qualitative risk criteria is common, whereby consequence, impact or probability factors are based on a qualitative description. This approach results in a qualitative risk rating in the form of a matrix, with the risk rating often described as low, medium, high or very high. Whilst appropriate for simple risk assessments, this approach has limitations as the risk ratings can be to broad, it does not allow for an accurate comparison and prioritisation of risk mitigation options or an assessment of residual risk (Rosen *et al.*, 2010).

A CBA approach requires the consequence and impact criteria to be allocated a financial value, commonly called a cost of failure value. These values will usually be predefined based on analysis of historical failure events. In the United Kingdom, the Common Framework for Capital Maintenance Planning (UKWIR, 2002) advocates this approach, and as such all water utilities now use risk based CBAs when developing capital investment plans (Thames Water, 2013). This allows for risks to be quantified and mitigation options to be compared and prioritised, thereby balancing residual risk, cost and benefit. Furthermore, whole life costing requires the cost of risk to be considered. Whole life cost is the total cost of ownership over the lifecycle of the asset and includes capital and operational costs as well as the cost of risk and benefit of risk reduction. It has been recognised that the incorporation of risk analysis in whole life costing can help anticipate the impacts due to risks and uncertainties, and assist the decision making process (Boussabaine & Kirkham, 2005). Various approaches to whole life costing and life cycle costing are described in a report by Davis Langton Management Consulting (2006).

Multi-criteria decision analysis and fault tree analysis are two other methodologies that are commonly used by water utilities to integrate costs into risk decision making. Decision trees are a technique that comprehensively displays alternatives or scenarios for a project in a tree-like structure. In an investment decision-making process, the costs, payoffs, and probabilities for the alternative can be assigned to the decision tree. The expected monetary value is computed by summing the payoffs weighted by their probability values. This technique assumes that the nature of projects is static. Such approaches allow for improved quantitative and probabilistic assessment of systems, and subsequently improves risk quantification and ranking compared to traditional impact and probability scales alone (Joerin *et al.*, 2009; Sadiq *et al.*, 2008).

Assessing cost and risk together offers the opportunity to prioritise risk mitigation options and hence develop optimised intervention plans. However, real costs are subject to fluctuation on annual or even less frequent time scales. Factors such as the weather, foreign exchange rates and inflation, commodity and energy prices all influence the cost to treat and distribute water (Renzetti & Kushner, 2004). For water utilities, managing cost volatility is particularly challenging as water bills and tariffs are often set for defined periods by regulators or politicians. Furthermore, cost is sensitive to demand, so if demand quickly increases due to prolonged hot weather or a major burst water main, the cost of production also increases. Short term cost volatility can be mitigated by forward contracts to fix prices, a common approach when purchasing energy.

More advanced modelling methodologies have been used in the energy sector that consider the correlation between total production cost, unit cost and demand; and the effect of various mitigation options on risk and cost (Falbo *et al.*, 2010). Similar modelling approaches could be used in the water sector.

2.9.4 ASSET PERFORMANCE & CONDITION

Risk assessment and management is a critical requirement to allow a water utility to benefit from optimised asset decision making. Effective and mature asset management decision making facilitates the constant trade-off between risk, cost and performance. Understanding asset criticality is important as this informs the asset strategy and the decision making tools and processes. Assessing criticality requires an organisation to understand the consequence of asset failure or the impact of a failure, which needs to be aligned to the organisations vision, mission, policy, objectives and risk management criteria (Institute of Asset Management, 2011). The discipline of risk management relating to assets and infrastructure is continually evolving, particularly with the advent of computing power, data analysis and diagnostic tools and techniques. There are now many innovative and powerful approaches that can support effective decision making at all levels of an organisation. Many water utilities use advanced modelling approaches to better understand risk, condition, cost and performance of their assets and systems. The use of advanced modelling has many benefits but to have complex risk decision support tools (DST) is not always appropriate, particularly for organisations who do not have the capacity or where the data is lacking.

Deterioration modelling is a commonly used risk based methodology that describes the process and mechanisms by which assets deteriorate and fail over time (Gilpin-Jackson, 2010). Deterioration models use a combination of statistical functions or observed data to forecast when an asset is likely to fail, and this information can be used to make risk based asset lifecycle decisions, such as when to maintain, refurbish or replace the asset. The Environment Agency in the United Kingdom regularly use such models to manage flood defence infrastructure (Environment Agency, 2009). Geographical Information Systems (GIS) are often utilised in asset management through a range of techniques from the simple coupling of GIS techniques with infrastructure data (Booth & Rogers, 2001) to the complex integration of GIS with hydraulic simulations (Lindley & Buchberger, 2002). When deterioration modelling is coupled with GIS and hydraulic modelling technology, water utilities have a very powerful tool for assessing asset risk, particularly of pipelines. Detailed methodologies are described by Chughtai & Zayed (2008) and Palmer-Jones *et al.* (2006).

McDonald (2014) describes a DST used to understand the risks associated with sewage pumping station failure. The DST uses a combination of probability of asset failure and consequence of asset failure. Probability of asset failure is determined through deterioration modelling using historic emergency work order data. The consequence is calculated by overland flow modelling, identifying the receptors at risk and then allocating a monetised cost of failure value for each receptor. The outputs of the DST allowed the water utility to make informed decisions that were directly related to asset performance, deterioration and consequence of failure.

Yorkshire Water in the United Kingdom is using a new generation of holistic risk analytical tools that can analyse risk, cost and performance in an end-to-end and integrated manner (Herndlhofer *et al.*, 2014). The utility has developed two models – a source to sea model that allows for assessment at a catchment scale, and a sludge model to understand costs and risk associated with sludge treatment and handling. Both of the models are used in operational and strategic planning to understand costs and performance of the assets and how these may change under various scenarios (such as increase in the electricity price or water content of sludge) or when subjected to constraints (such as maximise profit or minimise energy use).

A common tool used in systems engineering is Failure Mode and Effect Analysis (FMEA). This tool involves reviewing the components and sub-components of a system to identify failure modes, and their causes and effects. The effects are quantified based on likelihood and consequence and therefore risk is a central part of this tool. An FMEA is mainly a qualitative analysis however more advanced approaches do exist that are capable of utilising real performance, condition, failure and consequence data to give a quantitative assessment (Rausand & Hoylan, 2004). The safety of large bulk water storage facilities such as dams and reservoirs is important. Many water sectors around the world have developed frameworks, tools and methodologies for understanding the risk associated with these facilities (Bowles, 2000; Brown *et al.*, 2008; CIRIA, 2000; Munger *et al.*, 2009). Morris *et al.* (2009) proposed a source-pathway-receptor approach that systematically identifies the various components of a system and then quantifies likelihood of an event occurring and the consequences of the event. **Figure 2.8** shows this approach for a large dam.

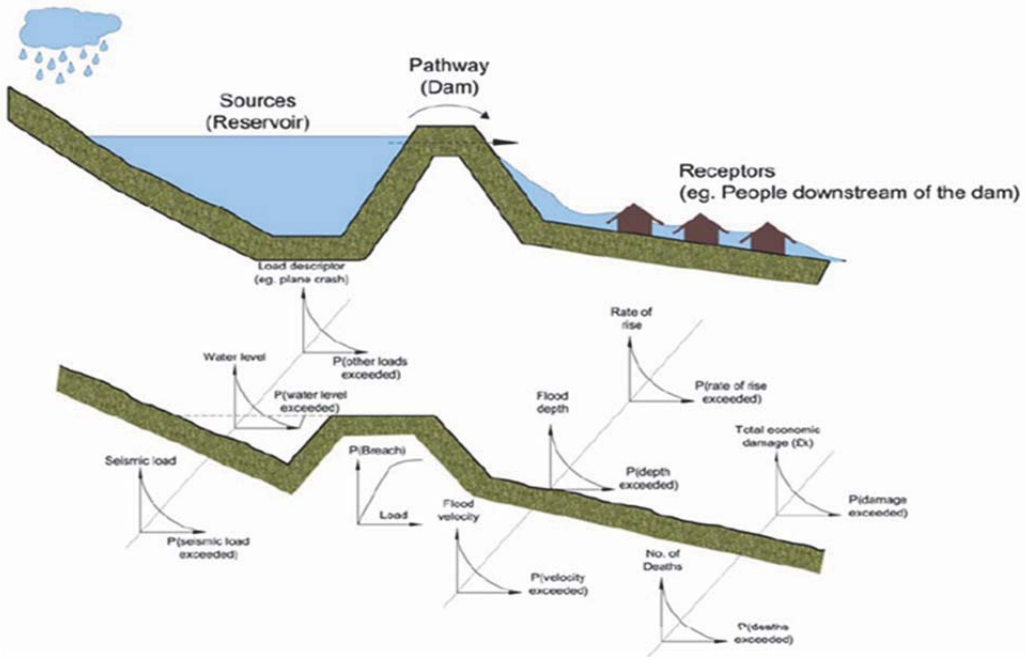


Figure 2.8: Source-pathway-receptor model for dam risk assessment (Morris et al., 2009)

2.9.5 PROJECT DELIVERY

Water utilities have large and complex capital programmes. Such programmes all have a degree of risk, particularly associated with delivering on time and within cost (Schuyler, 2001). Various well established capital project risk management methods and approaches have been developed (Chapman & Ward, 2003). The uncertainty around delivering large capital projects can be partially mitigated by providing a contingency. Alarcon *et al.* (2011) describes a methodology used in the delivery of the Panama Canal extension project, whereby the value of the contingency was determined using a risk and cost model. The model was based on a Monte Carlo simulation that used various costs and schedule estimates and the main risk factors affecting these. By running multiple simulations the total cost and completion date distributions were obtained and this was used to determine the total contingency required based on industry standards and the risk appetite of the client and project delivery team.

2.9.6 CLIMATE CHANGE

The impacts of climate change are already being felt by many water utilities around the world, with flooding and droughts the two most common impacts. Both flooding and droughts can significantly impact service delivery, cost and reputation. Schultze (2005) summarises various climate change scenarios in the South Africa water sector, their potential impacts and possible adaptation. Water utilities need to consider climate change risks to ensure they have suitable plans in place to mitigate the impacts (Dischel, 2002; Evens *et al.*, 2004; Water UK, 2007).

In Australia climate change is resulting in longer and hotter summers that is causing a security of supply risk. The prevalence of fires is also increasing which causes a water quality risk (CSIRO, 2014). In the South Australia Water Corporation climate change is considered at all levels in the organisation, from a strategic perspective at the board, right down to a tactical perspective in operations and planning. There is a clear climate change policy and strategy that guides all decision making and climate change risks are specifically identified and monitored on the corporate risk register. At a tactical planning level climate change impacts are considered when developing investment plans and in many cases results in the consideration of alternative options to ensure security of supply, such as desalination and wastewater reuse (Crocker *et al.*, 2014).

In the United Kingdom, various guidelines and risk assessment methodologies have been developed that details the approaches organisations can follow to understand and manage climate change risk (Water UK, 2007; Defra, 2012). One such methodology is real options analysis which has been applied to decision making about flood protection investment options. One flood protection option could be designed to be upgradeable in the future should the impact of climate change materialise, but this will come with a capital cost. The alternative option would be a non-upgradeable option that is less costly. The costs and benefits of each option together with the probabilities of climate change impacts occurring (in this case flooding) are mapped in a decision tree. This allows for a comparison of options based on cost, benefit and probability and can also allow for sensitivity analysis (HM Treasury & Defra, 2009). The same principles could be applied to

many capital planning scenarios such as sizing of storm water pipes or selection of water resource development options. Given that water utilities build assets with long design lives and the current future uncertainty of climate change impacts, a real options analysis approach to capital planning could result in better decision making to increase long term resilience.

2.9.7 SUPPLY CHAIN

Public procurement is the government activity of purchasing the goods and services needed to perform its functions and is therefore central to water infrastructure delivery (Arrowsmith, 2010). The water sector value chain has many diverse stakeholders; with the private sector playing a significant role as providers of engineering consulting services and infrastructure construction. A supply chain management system must consider risk to ensure the system delivers best value for money in the long term. This is particularly important in the decision making and subsequent procurement of infrastructure and the engineering services that support a project lifecycle (HM Treasury, 2013). In an increasingly globalised world with extended supply chains and supplier consolidation, organisations can benefit from choice, efficiency and effectiveness, however this can also make supply chains more susceptible to disruption. Events far removed from the organisation can have a serious impact, for example increasing commodity prices may increase the cost of construction projects, or a major flooding event may disrupt transportation of essential goods (Waters, 2011). Embedding a risk management system with the supply chain management system will assist in identifying and managing such risks (Supply Chain Risk Leadership Council 2011). The risk management strategy used will depend on the nature of the business and the context of the operating environment. Manuj & Mentzer (2008) describe six possible strategies that can be used to manage global supply chain risks.

As supply chains involve multiple stakeholders, a collaborative approach is needed which should be considered from multiple perspectives. Peck (2005) suggests that four levels of analysis need to be undertaken – product or process value stream, asset and infrastructure dependencies, organisations and inter-organisational networks, and social and natural environment. The water sector in the United Kingdom are moving towards partnership models such as frameworks and alliancing which includes a supply community rather than a supply chain, and in doing so hope to benefit from collaboration and sharing of knowledge, including a sharing of risk and reward (Waller, 2013).

In South Africa the concept of risk “outside the boundary fence” is not new with organisations like SABMiller taking the lead in identifying and managing water related risks in their supply chains and geographical areas of operation (SABMiller, 2014; Water Futures Partnership, 2011). The business uses water footprinting to better understand ecological, social and business risks in their supply chain. They realise that water scarcity in certain catchments is both a risk to their operations and to the local communities, and through collaborative partnerships they develop plans to mitigate the joint risk. This provides a benefit to their business and also the local communities. Other water sector stakeholders, particularly water utilities could follow similar approaches to understand shared risk more holistically.

2.9.8 SHARED RISKS & ASSET INTERDEPENDENCIES

The water sector and all of its stakeholders rely upon an array of complex national and international infrastructure systems, such as supply chains, transportation, utilities, telecommunication and financial. It is recognised that a series of incidents could interact and result in a cascade affect across critical infrastructures resulting in a major service failure. In 2014 parts of Johannesburg experienced water shortages for many days when an electrical fault with a substation owned by the electricity utility resulted in a failure of a critically important water pumping station owned by the water utility. Much research has been undertaken exploring critical asset and system interdependencies (Dunn & Wigert, 2004; Rinaldi *et al.*, 2001). Traditional analysis of interdependencies involves characterisation of infrastructure-to-infrastructure linkages to identify the key infrastructure components that, if lost or degraded, could adversely affect the performance of other infrastructure. While modelling and simulation tools have provided insight into the behaviour of individual infrastructure networks, far less is understood of the interrelationships among multiple infrastructure networks including the potential cascading effects that may result due to these interdependencies (Rinaldi *et al.*, 2001).

From a risk perspective, cross sector analysis also must involve identifying and characterising a wide range of threats, vulnerabilities and consequences of loss. Such information provides a foundation for making defensible, cost-effective infrastructure protection and operation decisions to ensure the security and reliability of our interdependent systems. However such an approach will require partnering and the sharing of information in a joined up and collaborative manner, something that is not common (Dunn & Wigert, 2004). One such way of sharing is to have a joint risk register, which is common in the public sector in the United Kingdom. This will provide the opportunity to come to agreed judgements, allocate responsibility for action and interventions based on a common understanding of each organisation’s needs. A shared risk register ensures complete understanding for both parties about risks to ongoing service delivery, and enables a joint approach to managing risks. Clarity of who is responsible for, and manages, which risks is also essential.

CHAPTER 3: DEVELOPMENT OF A RISK MATURITY MODEL

3.1 INTRODUCTION TO MATURITY MODELS

Benchmarking is a commonly used way for an organisation to compare its performance against peers or a defined standard. In many sectors of industry, performance indicators and benchmarking exercises are widely used as management tools for gaining and maintaining continuous improvement and competitive advantage (Parena *et al*., 2002). A number of benchmarking tools have been developed across various sectors and industries. Some of these tools are generic and can be used across various sectors and industries, whilst others are specific to a particular sector or industry. A maturity model can be viewed as a set of structured levels that describe how well the behaviours, practices and processes of an organisation can reliably and sustainably produce required outcomes. Risk management maturity can be benchmarked and improved through the use of risk maturity models. Risk maturity models are much needed barometers for risk management stakeholders and provide a stepping stone approach to assist organisations in progressively reaching desired maturity levels. Coetzee & Lubbe (2013) outline the main components of a risk maturity model:

1. A structured and systematic approach
2. With a list of current generally accepted criteria
3. Used as a benchmark against which to evaluate the organisation's risk management framework
4. To determine the maturity or level of implementation of the risk management framework

A number of the leading risk maturity models are based on capability maturity models (CMM). The CMM concept was first developed by the Software Engineering Institute in the United States for the purposes of measuring information technology maturity (Paulk *et al*., 1993). A CMM is a simplified representation of an organisational discipline that distils industry practices into a coherent, process-based framework. Though the model comes from the field of software development, it is also used as a general model to aid in business processes and has been used extensively by organisations around the world. These models comprise:

1. Different levels of maturity, from learner to best practice and a description of each stage of development
2. Assessment criteria describing the quality of the risk management practices within each level
3. The competencies describing the desired capabilities, linking the levels to the criteria

A number of water sector benchmarking tools have been developed. The Environmental Protection Agency (2008) together with six water and sanitation organisations developed a generic benchmarking tool for water utilities in the United States of America to measure their overall management capability. Ten capability areas were identified including product quality, customer satisfaction, leadership, operational optimisation, financial viability, infrastructure stability, community and environmental sustainability, water resource adequacy and stakeholder understanding. In South Africa, the Municipal Benchmarking Initiative is a join project by the Water Research Commission and the South African Local Government Association. Municipalities voluntarily

submit various performance data that is then published in an aggregate format and can subsequently be used to compare performance for the purpose of continual improvement and development (Municipal Benchmarking Initiative, 2014). In the United Kingdom the Institute of Asset Management have produced a benchmarking tool called the self-assessment methodology to assess an organisations asset management maturity against the ISO55000 standard (Institute of Asset Management, 2014). **Figure 3.1** shows the output the self-assessment methodology benchmarking tool.

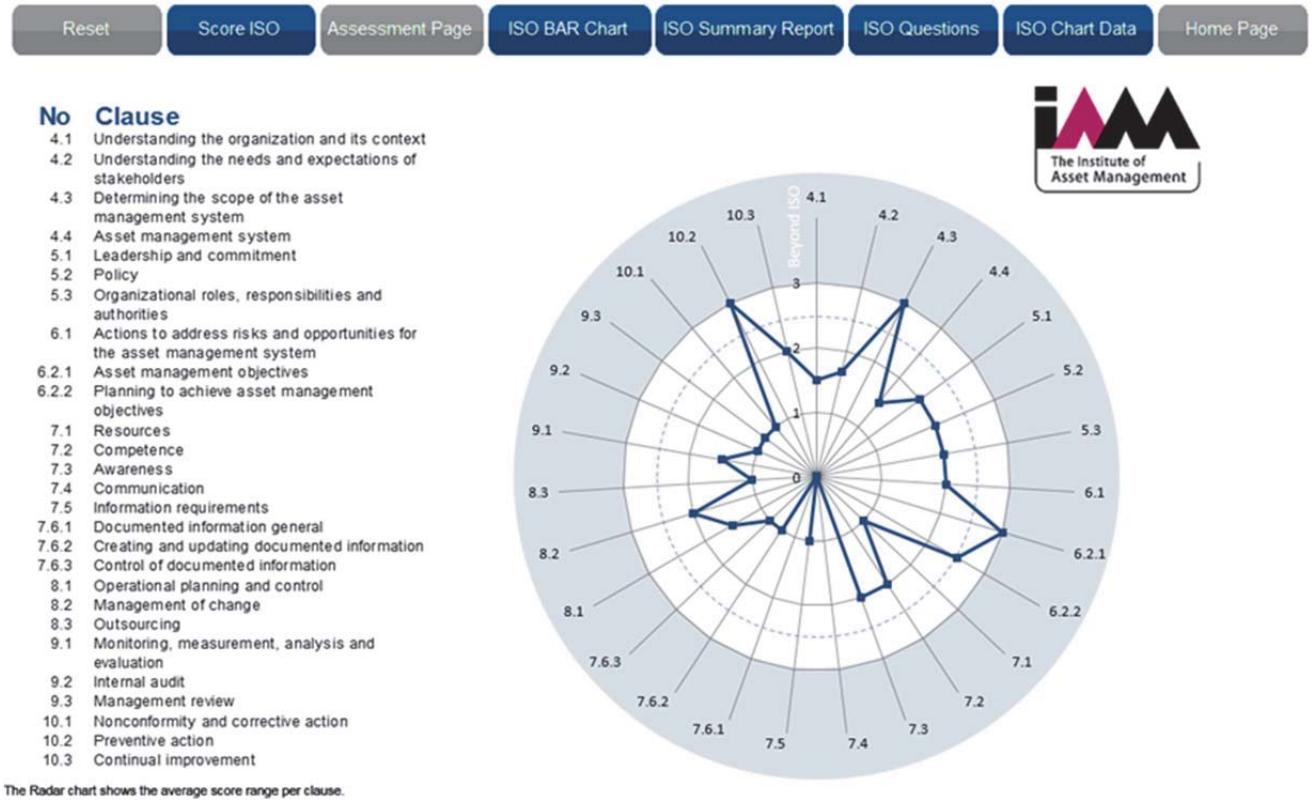


Figure 3.1: Asset management benchmarking output (Institute of Asset Management, 2014)

Risk specific capability maturity models have been developed by Coetzee & Lubbe (2013) and Yeo & Ren (2009) with both models defining maturity levels and the criteria required to reach each level. MacGillivray *et al.* (2007) developed a risk maturity model specifically for water utilities. The model identifies 11 risk management processes which are separated into five maturity levels, from basic to best practice. These maturity levels, characterised by reference to key attributes reflect the extent to which each process is defined, institutionalised and controlled. The qualities that characterise each maturity level indicate the maturity of the organisation. **Figure 3.2** shows the maturity model components.

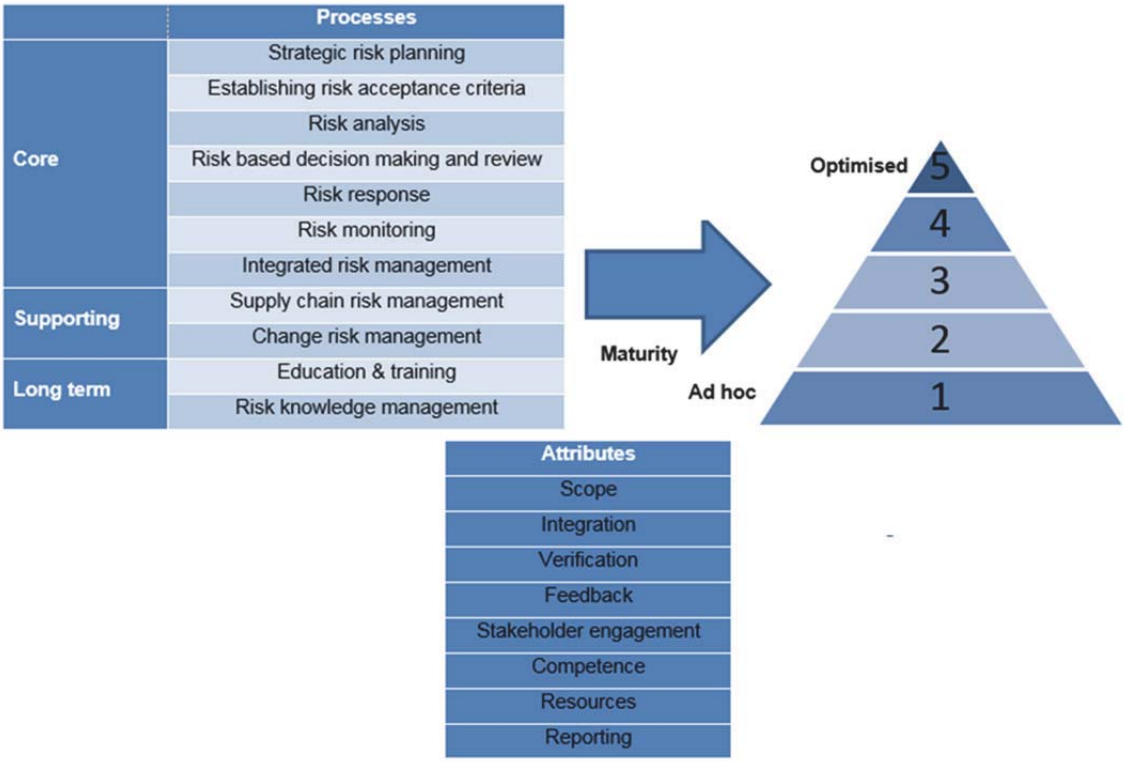


Figure 3.2: Maturity model components (MacGillivray et al., 2007)

3.2 RISK MATURITY MODEL DEVELOPMENT

In order to systematically and objectively assess the risk maturity of South African water utilities, a risk maturity model was developed (CD attached). The model was designed to benchmark risk management capabilities in the South African water sector. Key development inputs included an extensive literature review on risk management in the water sector, risk maturity models and capability maturity modelling, and past experience within the sector. There are many models available to benchmark risk management maturity, both in the water sector and in other industries (Hillson, 1997; IACCM, 2002; IIA (UK & Ireland), 2003; Hopkinson, 2004; Spencer Pickett, 2005; RIMS, 2006; MacGillivray et al., 2007; Yeo & Renn, 2009; Coetzee & Lubbe, 2013). Furthermore, there are a number of maturity models that are not specifically related to risk but are relevant to the water sector (Environmental Protection Agency, 2008; Institute of Asset Management, 2014). Most of these models were developed outside of South Africa so to make the model relevant, the National Treasury Public Sector Risk Management Framework (National Treasury, 2010) and the South African Institute of Risk Management Risk Management Guidelines (South African Institute of Risk Management, 2014) were reviewed. Also reviewed were the ISO31000 standard (International Standards Organisation, 2009) and the King III Corporate Governance Code (King, 2009). **Table 3.1** summarises seven of the models that were assessed in detail. Of these seven, five were specifically related to risk and were diverse enough to identify the common criteria and concepts used in risk maturity models to inform the design of the model.

Table 3.1: Comparison of various maturity models

Model	Maturity levels	Criteria									
Risk maturity model (Hilson, 1997)	Naïve Novice Normalised Natural	Culture	Process	Experience	Application						
Business risk maturity model (IACCM, 2002)	Novice Competent Proficient Expert	Culture	Process	Experience	Application						
Self-assessment methodology (IAM, 2014)	Innocent Aware Developing Competent Optimised	Context	Leadership	Planning	Support	Operations	Performance	Improvement			
Risk maturity model for ERM (RIMS, 2006)	Ad hoc Initial Repeatable Managed Leadership	Approach	Process	Appetite	Cause	Uncover risks	Perform	Sustainability			
Risk maturity model (Coetzee & Lubbe, 2013)	Ad hoc Initial Repeatable Managed Optimised	Culture	Strategy	Policy	Process	People	Performance	Internal audit	Reporting		
Water utility maturity model (EPA, 2008)	1 2 3 4 5	Product quality	Customer satisfaction	Employee & leadership development	Operational optimisation	Financial viability	Infrastructure stability	Operational resilience	Community & environment	Water resource adequacy	Support
Risk management benchmarking model (McGillivray et al., 2007)	Initial Repeatable Defined Controlled Optimised	Strategic risk planning	Risk culture	Risk analysis	Decision making	Risk response	Monitoring	Integration	Supply chain	Training	Knowledge

3.2.1 MATURITY LEVEL CHARACTERISTICS

All the models that were reviewed had either four or five maturity levels. The literature review suggested that South African water sector organisations will have a wide range of maturity levels. Therefore five levels were selected to give a broader range of maturity levels, which would be more applicable to the South African context. **Table 3.2** shows the general characteristics of each maturity level.

Table 3.2: Maturity level characteristics

Level	Characteristics
Level 5 – optimised	Proactive, intelligent risk taking whereby opportunities are rewarded, using the risk management system as competitive advantage, driving continuous improvement and adding value, embedded risk culture whereby everyone is a risk manager, risk management is a central part of all business activities and decision making with risk management happening all the time, adaptability and flexibility, attention to organisational culture, human behaviour and learning in which the organisation and its people are always improving, collaborative partnerships with internal and external stakeholders and there is open shared learning, leadership driven
Level 4 – managed	Risks identified, analysed, treated and monitored at an enterprise level, processes, procedures and systems in place to work across all functional boundaries, integrated response to events, systems and performance metrics are in place to evaluate the effectiveness of the risk management system, data actively used to improve business processes and provide assurance, key stakeholders are consulted and involved in decision making, a risk aware culture is becoming established, more proactive then reactive, management driven, some inflexibility limits the capacity for deeper learning and collaboration
Level 3 – defined	Defined and formalised policies, processes and procedures in place across the organisation but still business function orientated, risks are routinely identified, analysed, treated and monitored, combination of reactive and proactive, adequate training, budgets and tools are in place to support risk management activities, some performance monitoring and feedback mechanisms but still restricted in the ability to adapt and learn, established management support, less vulnerable to change
Level 2 – initial	Recognition of the need for and benefits of risk management, some processes or procedures are in place, discrete roles established for sub sets of risks in teams or departments, reliance on people is reduced, risk management is narrow in scope and still mainly reactive, restricted to meeting regulatory requirements, limited performance monitoring, some management support, vulnerable to change
Level 1 – ad hoc	Unaware of the need for and benefits of risk management, limited or no awareness of standards and guidelines, ad-hoc approach with no defined processes or procedures in place, reliant on individual capabilities or heroics for identification and management of risks, entirely reactive approach taking each challenge as it comes, little or no management support, highly vulnerable to change

The five maturity levels in the model distinguished between mature and immature organisations and the descriptions characterise the organisational behaviours and processes at each level. These levels were derived from extracting principles from the models in table 6 and the principles of CMMs. The journey to risk management excellence can thus be seen as the progression from one maturity level to the next, as the institution develops the qualities and capabilities necessary to mature. The characteristics and processes at each level provide a road map to becoming risk mature and provide goals for improvement. It must be noted that in reality some organisations may demonstrate certain characteristics in one maturity level and other characteristics in another maturity level.

3.2.2 CRITERIA & COMPONENTS

The models that were reviewed had a wide range of criteria. There were a number of criteria that were common to most of the models including culture, leadership and risk process. **Table 3.3** summarises the criteria and components in the model as well as a rationale for each criteria.

Table 3.3: Criteria, components and rationale

Criteria	Rationale	Components
Strategic Planning	The consideration of risk and opportunity must be part of strategic business planning. Organisational objectives must be defined and the risks of not meeting them (or the opportunities to meet or exceed them) must be identified and managed. Risk appetite and tolerance must be defined by the board or senior management. There must be overall alignment and line of sight between strategic objectives, risk appetite and tolerance and strategic activities and the tactical day to day risk management activities (and visa versa).	1.Organisational strategic objectives 2.Risk appetite and tolerance 3.Line of sight 4.Strategic risk assessment
Risk Policy & Framework	A documented and communicated risk management framework must be in place that defines and sets out the processes, procedures, methodologies, responsibilities, communication and decision making structures for risk management. Risk criteria must be consistently defined. The framework must be underpinned by a risk policy which is endorsed by the board or senior management. The policy and framework should be informed by an international and/or local standard or guideline. The policy and the framework must be well communicated, actively implemented and the benefits measured. Risk management must occur within the broader context of good and effective governance. Senior management and political office bearers must have the correct systems and structures in place to enable effective and transparent governance aligned to best practice corporate governance principles. Accountability to all stakeholders must be upheld.	1.Risk policy 2.Risk management framework
Risk Based Decision Making	Risk must be a central part of all business decision making, at all levels in the organisation, from strategic through to tactical. Asset management decision making in particular must find a balance between cost, performance and risk. Decision making structures, responsibilities and procedures need to be defined and implemented. Decision making must use best available and objective information, be inclusive, transparent, and collaborative and result in appropriate outcomes that align to the organisational objectives and risk appetite and tolerance.	1.Decision making structures and procedures 2.Tools, systems and methodologies 3.Consultation and integration 4.Risk control assurance

Project Risk Management	The implementation of projects results in change and therefore comes with risks. In particular large value and complex capital schemes have many inherent risks associated with them. Organisations must have appropriate processes, procedures and systems in place to manage risks associated with projects throughout their lifecycle.	1.Decision making structures and procedures
People & Resources	The people in an organisation are the most important factor determining the success of risk management and governance. The right people with the right skills, attitude and behaviour need to be in place, they need to be trained to do their jobs and provided with the appropriate resources, tools and remuneration. They need to be well managed.	1.Risk management responsibilities 2.Skills and capabilities 3.Training and development 4.Budget
Organisational Culture & Leadership	The culture of an organisation significantly influences risk management. Culture is the collective mind-set, behaviours, pattern of basic assumptions and beliefs that shape and influence actions, inter-actions and decisions. Leadership plays a critical role in shaping the culture by setting the right tone from the top, leading by example and driving and managing behaviours and performance of teams and individuals.	1.Tone from the top 2.Risk mindfulness and awareness 3.Change management 4.Continuous improvement
Knowledge Management	A systematic approach is required to identify, monitor, store, interpret and use data, information and knowledge relating to risk. Knowledge needs to be retained through succession planning and codifying of procedures and processes.	1.Risk knowledge system 2.Risk reporting 3.Institutional knowledge
Business Continuity & Emergency Preparedness	No matter how good an organisation is regarding risk management, there will always be the occasion when risks materialise. It is important that an organisation has plans in place to manage disrupting events and that the plans are communicated and all stakeholders know their responsibilities.	1.Continuity and emergency plans
Performance Management	Monitoring and review of the risk management policy, framework, implementation plan, governance structures and risk systems and activities is necessary to drive continuous improvement and to advance on the journey to excellence. A mix of hard and soft key performance indicators must be identified and monitored through a risk performance management system to ensure all risk activities are adding value and to identify areas for improvement.	1.Performance management system

3.2.3 MAPPING OF CRITERIA

Table 3.4 shows how the model criteria map to key legislation, standards and guidelines.

Table 3.4: Mapping of criteria

		Strategic Planning	Risk Policy & Framework	Risk Based Decision Making	Project Risk Management	People & Resources	Organisational Culture & Leadership	Knowledge Management	Business Continuity & Emergency Preparedness	Performance Management
Treasury Risk Management Framework	Item 5						✓			
	Item 6	✓								
	Item 7		✓							
	Item 8		✓							
	Item 9			✓		✓				
	Item 10					✓				
	Item 11			✓						
	Item 12					✓				
	Item 13		✓	✓						
	Item 14		✓	✓						
	Item 15	✓	✓	✓	✓					
	Item 16		✓	✓						
	Item 17		✓	✓						
	Item 18		✓	✓						

Treasury Risk Management Framework	Item 19							✓		
	Item 20									✓
	Item 21		✓			✓	✓			
	Item 22		✓			✓				
	Item 23		✓			✓				
	Item 24		✓			✓				
	Item 25		✓			✓				
	Item 26		✓			✓	✓			
	Item 27					✓				
	Item 28					✓				
	Item 29		✓							
	Item 30		✓							
	Item 33									✓
	Item 34									✓
King III	Principle 1.1	✓					✓			
	Principle 2.1	✓	✓							
	Principle 2.6		✓							
	Principle 2.7						✓			
	Principle 2.10		✓							

King III	Principle 2.23		✓							
	Principle 3.1		✓							
	Principle 4.1		✓			✓	✓			✓
	Principle 4.2	✓								
	Principle 4.3		✓			✓				
	Principle 4.4		✓			✓				
	Principle 4.5		✓	✓						
	Principle 4.6		✓	✓						
	Principle 4.7		✓	✓						
	Principle 4.8		✓	✓						
	Principle 4.9		✓	✓						✓
	Principle 4.10							✓		
	Principle 5.5		✓	✓						
	Principle 6.3		✓	✓						
	Principle 7.1		✓			✓				
	Principle 7.2		✓			✓				
	Principle 7.3									✓
	Principle 8.1			✓						
	Clause 4.2						✓			

ISO 31000:2009	Clause 4.3		✓	✓		✓				
	Clause 4.4		✓							
	Clause 4.5									✓
	Clause 4.6						✓			✓
	Clause 5.2	✓	✓	✓						
	Clause 5.4		✓	✓						
	Clause 5.5			✓						
	Clause 5.6			✓						✓
	Clause 5.7							✓		
PFMA	38(1)					✓	✓			
	51(1)					✓	✓			
MFMA	62(1)					✓	✓			
	78(1)					✓				
	95(c)					✓	✓			
	165(1,2)		✓			✓				
	166(2)		✓			✓				
Disaster Management Act	42								✓	
	52								✓	
	53								✓	

3.2.4 CORE QUESTIONS

Each component had a core question and a number of sub questions. The responses to each question and supporting evidence provided allowed the assessor to make a judgement as to the maturity level for that component. An assessment of this nature is mostly subjective. The outputs of the model are highly dependent on the honesty and accuracy of the interviewee responses, the evidence provided and the assessor interpretation of this. Where a response or evidence is not adequate enough to make an informed assessment, that component should not be scored. **Table 3.5** shows the core questions for each component.

Table 3.5: Core questions

Criteria	Component	Core Questions
Strategic Planning	1.Organisational strategic objectives 2.Risk appetite and tolerance 3.Line of sight 4.Strategic risk assessment	1. Can you demonstrate that your organisation has identified, documented and communicated a set of strategic organisational objectives? 2. Can you demonstrate that your organisation has identified, documented and communicated risk appetite and tolerance? 3. Can you demonstrate that there is line of sight between strategic activities, objectives and risks and the tactical or operational activities? 4. Can you demonstrate that you routinely consider the risks and opportunities of meeting or not meeting your strategic objectives? For example undertaking a strategic risk assessment.
Risk Policy & Framework	1.Risk policy 2.Risk management framework	1. Can you demonstrate that your organisation has a documented, communicated and implemented risk policy? 2. Can you demonstrate that your organisation has a documented risk management framework/strategy/plan?
Risk Based Decision Making	1.Decision making structures and procedures 2.Tools, systems and methodologies 3.Consultation and integration 4.Risk control assurance	1. Can you demonstrate that your organisation has identified, documented and communicated appropriate decision making structures, procedures, responsibilities and accountabilities? 2. Can you demonstrate that your organisation consistently and systematically uses appropriate risk based tools, systems and methodologies to inform decision making at a strategic, operational and project level and that decisions are made based on objective evidence rather than subjective or expert opinion? For example SCADA, condition/performance data, deterioration modelling, root cause analysis, whole life costing or cost benefit analysis, fault tree analysis, GIS, FMEA, Monte Carlo simulation, workshops, expert judgement to validate? 3. Can you demonstrate that your organisation has effective cross functional decision making arrangements between teams, departments and directorates? 4. Can you demonstrate that your organisation has a systematic process in place to design controls and treatments and to assess their effectiveness?
Project Risk Management	1.Decision making structures and procedures	1. Can you demonstrate that your organisation has established processes, procedures, systems, responsibilities and accountabilities in place to manage project risks?

People & Resources	1.Risk management responsibilities 2.Skills and capabilities 3.Training and development 4.Budget	1. Can you demonstrate that your organisation has identified, documented and communicated risk management responsibility to all appropriate people, and that this forms an explicit part of their job descriptions/performance contracts? 2. Can you demonstrate that your organisation has appropriately qualified and skilled people at all levels in the organisation to undertake risk management activities? 3. Can you demonstrate that your organisation has an appropriate training and development programme related to risk management activities? 4. Can you demonstrate that your organisation has appropriate budgets available to fund risk management activities and to cover the cost of risk controls and treatments and that these have been developed based on an assessment of risk?
Organisational Culture & Leadership	1.Tone from the top 2.Risk mindfulness and awareness 3.Change management 4.Continuous improvement	1. Can you demonstrate that senior management and leadership get actively and positively involved and support risk management? 2. Can you demonstrate that all employees know their contribution to providing safe water and sanitation services and can they explain this in risk terms? 3. Can you demonstrate that your organisation has and uses a formal documented system for the management of change? 4. Can you demonstrate that your organisation has systems and processes in place to foster continuous improvement and learning from past events?
Knowledge Management	1.Risk knowledge system 2.Risk reporting 3.Institutional knowledge	1. Can you demonstrate that your organisation has an appropriate and established risk knowledge management system to capture, store, analyse and disseminate data, information and knowledge relating to risk? 2. Can you demonstrate that your staff have access to the most up to date risk information quickly and use this to inform decision making? 3. Can you demonstrate that your organisation has an appropriate and established system in place to capture, store and manage institutional knowledge?
Business Continuity & Emergency Preparedness	1.Continuity and emergency plans	1. Can you demonstrate that your organisation has appropriate and established business continuity, emergency preparedness and disaster management plans that are documented, communicated, resourced and tested?
Performance Management	1.Performance management system	1. Can you demonstrate that your organisation has an appropriate and established risk performance management system to measure and assess how well the risk management framework/strategy/plan is being implemented?

3.2.5 APPLICATION OF THE RISK MATURITY MODEL

The model is designed for self-assessment by using an organisations internal resource or by using an external assessor. A reasonably good understanding of risk management and governance is required to undertake an assessment. However the assessors do not need to be subject matter experts on risk. The model has been created in Microsoft Excel to allow for a wide range of users (**CD attached**). The model can capture the results from up to five interviewees. Interviewees can be individuals or a group/panel of individuals. It is recommended that a representative vertical and horizontal cross section is interviewed. The target interviewees should include:

1. A chief risk officer (or equivalent) who has a detailed understanding of organisational or enterprise wide risk management and governance activities and practices
2. Senior member of an operational team, department or branch that has a detailed understanding of operational and tactical organisational activities and practices, including risk management

It is recommended that some data and information gathering is done prior to an assessment as this will save time during the assessment and will also allow the assessors to have some background information on the organisations risk management practices. During the assessment, the assessor systematically works through each criterion, assesses each component and captures the responses and evidence in the field provided. Each component is scored against the five point maturity scale, based on an evaluation and interpretation of the responses and evidence. The assessment is repeated for each interviewee. Each interview should take between two and three hours depending on the questions asked and the extent of the responses given. After each interview is completed and all the criteria and components have been scored, the summary page will display the aggregate findings. The scores for each component are displayed graphically against the five point maturity scale. If more than one interviewee provided a response, the score is an unweighted average of all the responses. A bar chart displays the minimum and maximum score for each component, which is an indication of the spread of scores. If there is a significant spread then the assessors can revisit that component to understand the reason for the spread. **Figure 3.3** shows the summary chart and the bar chart.

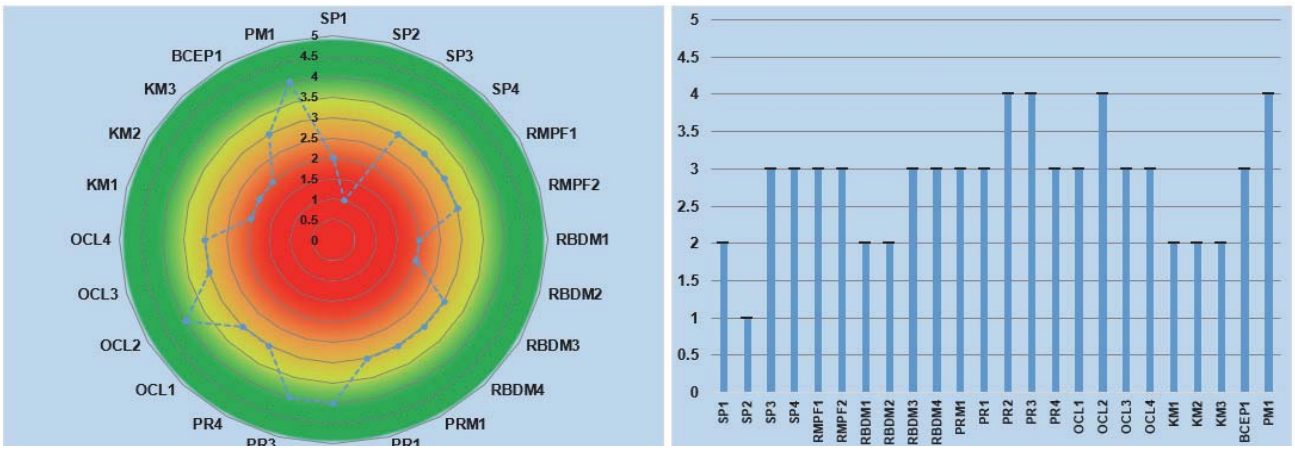


Figure 3.3: Summary of assessment results

CHAPTER 4: RISK MATURITY ASSESSMENT FINDINGS

4.1 STAKEHOLDER SELECTION

This study explored risk governance in the water services sector and the focus was therefore placed on organisations mandated by legislation to provide water services. Hence, participation was limited to water service authorities and water service providers, including water boards, municipal entities and municipalities. 170 organisations from around South Africa were invited to participate in the study via email communication and phone calls. Participation was voluntary and out of the 170 organisations invited, 13 agreed to participate while two declined and 155 did not respond. Of the eight municipalities, three were metropolitan municipalities and the two municipal entities both provide services to metropolitan municipalities. Organisations categorised as 'other' included private water utilities, catchment management agencies and private organisations that also provide water services. **Figure 4.1** shows a breakdown of the organisations and **Table 4.1** the response rate.

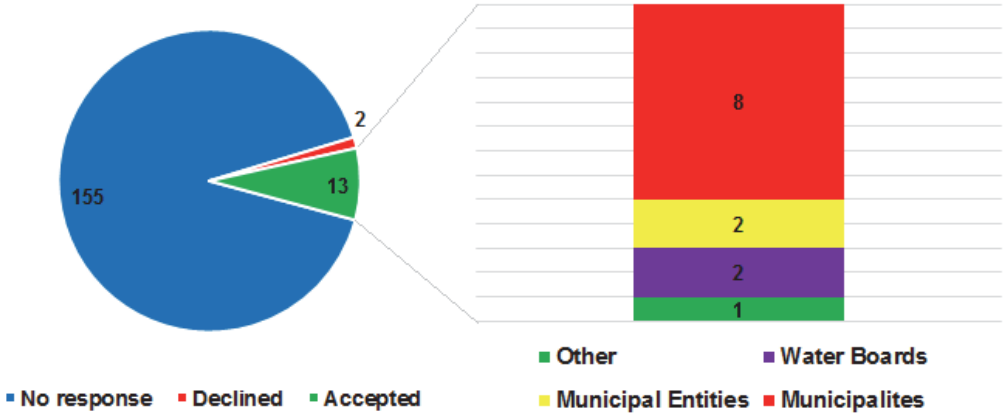


Figure 4.1: Breakdown of organisations

Table 4.1: Response rate

Organisation	Invited	Positive Response Rate
Municipalities	152	5.2%
Water Boards	7	28.5%
Municipal Entities	2	100%
Others	9	11.1%
Total	170	7.6%

The limitations in the response rate mean that the sample may be biased towards organisations that are most likely already undertaking effective risk management activities. As this study is voluntary, it is likely that organisations who do not practice sound risk governance would not want to participate, or have capacity constraints so did not have the time or resources to participate. Therefore the analysis is unlikely to be representative of the risk governance capabilities of the South African water sector as a whole. The study does cover a large part of the population (29 million out of 55 million) as shown in **Figure 4.2a**, by virtue of the size and locations of the organisations that did participate. The spatial distribution of the participants is shown in **Figure 4.2b.**

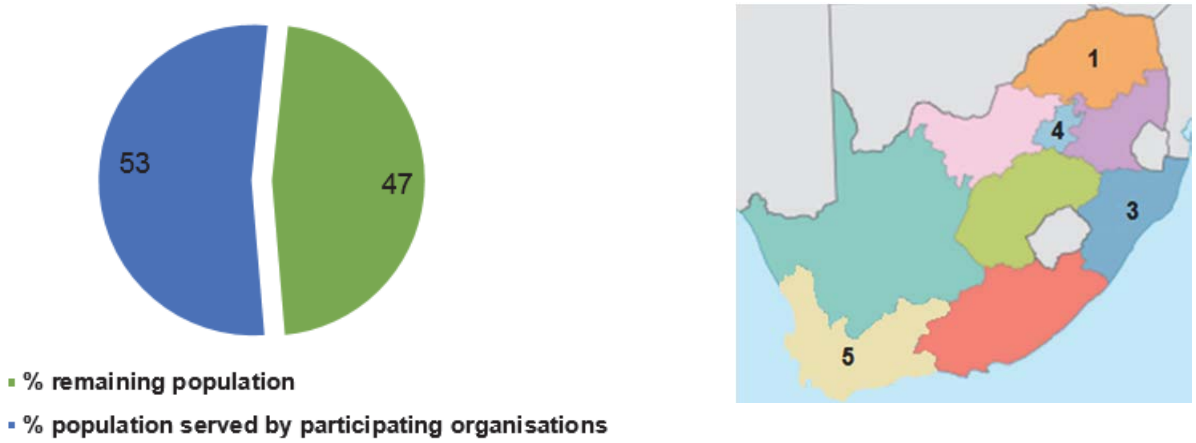


Figure 4.2: a) Population served, and b) Spatial distribution

Municipalities had the poorest positive response rate at 5.2%. This is limiting the study as these are the organisations that are facing the most acute challenges and in some cases struggling to provide safe, reliable and efficient water and sanitation services. Many municipalities have an insufficient revenue base and a reduced capacity to generate income to fund the provision of services. This often occurs in smaller rural municipalities where poverty and unemployment are higher compared to metropolitan municipalities. Municipalities are also struggling with skills shortages; the 2014 non-financial audit of municipalities identified an overall vacancy rate of 11.5% in municipal water and sanitation departments (Statistics South Africa, 2015). These challenges associated with lack of capacity, skills and resources in municipal water and sanitation departments are potentially some of the reasons that municipalities did not respond to the invitation to participate.

It is important to note that the identity of the individuals and organisations that participated has been kept entirely confidential throughout the course of the research. The study is intended to gain a broad understanding of how risk is governed in the water sector, not to compare one organisation to another. Furthermore, confidentiality was upheld to encourage participants to be as honest and accurate as possible in an effort to gain a true reflection of risk governance capabilities.

4.2 ASSESSMENT METHODOLOGY

The risk maturity assessments were conducted using the risk maturity model described in chapter 3 to assess a selection of stakeholders outlined above. The assessments took the form of semi-structured interviews with a range of one to four interviewees. The target interviewees were:

1. the chief risk officer (or equivalent) who has a detailed understanding of organisational or enterprise wide risk management and governance activities and practices
2. a senior member of an operational team, department or branch that has a detailed understanding of operational and tactical organisational activities and practices, including risk management

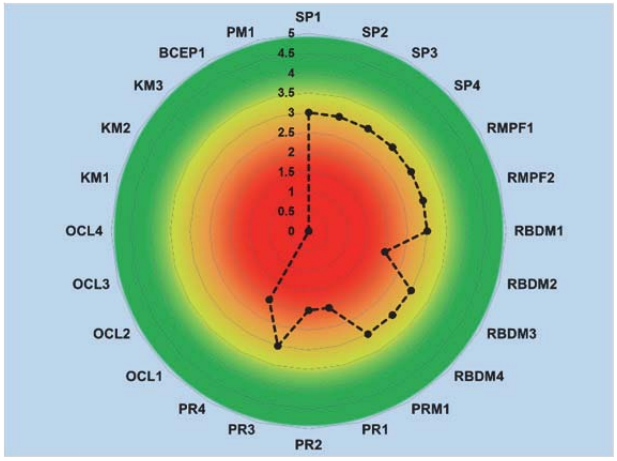
Interviews were conducted face-to-face with 12 organisations and by video call with one organisation and transcribed *verbatim* in the answer field provided in the model. Transcripts were returned to interviewees for comment and approval. In addition, relevant accompanying documentation was obtained from interviewees and the public domain both prior to and after the assessments. This included documents such as risk management policies and frameworks, water safety plans, wastewater risk abatement plans, extracts from the risk register, business continuity plans, standard operating procedures and emergency response plans.
Each organisation's maturity for the 24 components was scored against the associated component's maturity level descriptions. It must be noted that an assessment of this nature is mostly subjective. The output of the model is highly dependent on the honesty and accuracy of the interviewee responses, the evidence provided and the assessor interpretation of this. Also, the assessment was not an audit so in many cases the responses given were taken as true and there was no validation of the responses by checking documentation other than that voluntarily provided. If the response provided was not suitable enough to score then the score was left blank. The summary page then displayed the aggregate findings graphically against the five point maturity scale.

4.3 ASSESSMENT FINDINGS

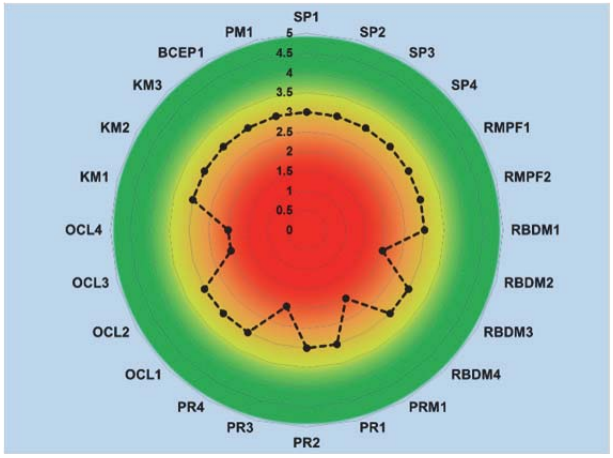
4.3.1 INDIVIDUAL ORGANISATIONS

Figures 4.3-4.5 show the results of each of the 13 organisations in graphical form. The charts are colour coded using red, amber and green to indicate the maturity level. As indicated by the colour transitions, the boundaries of the maturity scales are not hard values, rather a dynamic transition from one maturity level to the next. Refer to **Table 3.3** for the criteria used and the components for each criterion. Organisation 1 did not complete the assessment and as such did not have any score for OCL2 to PM1.

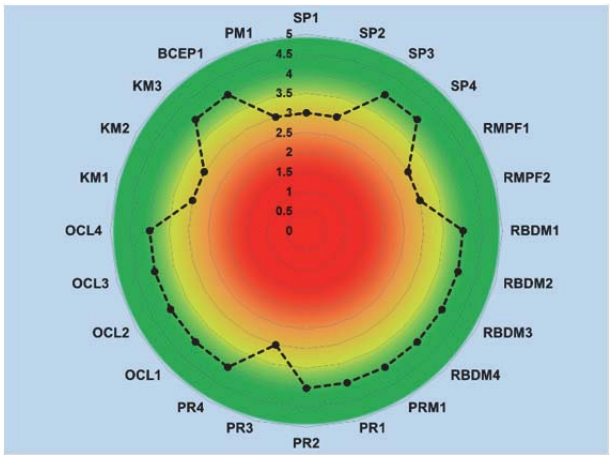
Organisation 1



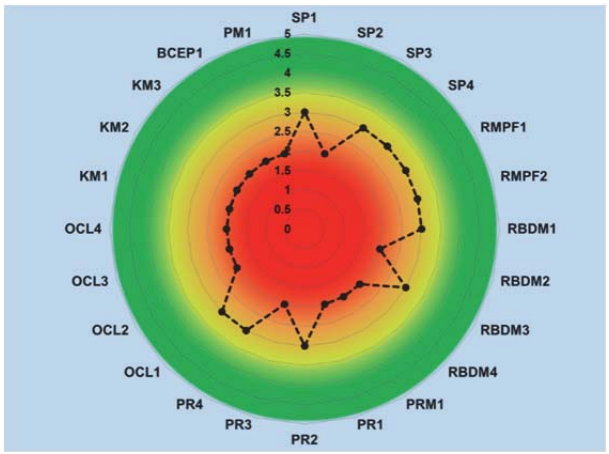
Organisation 2



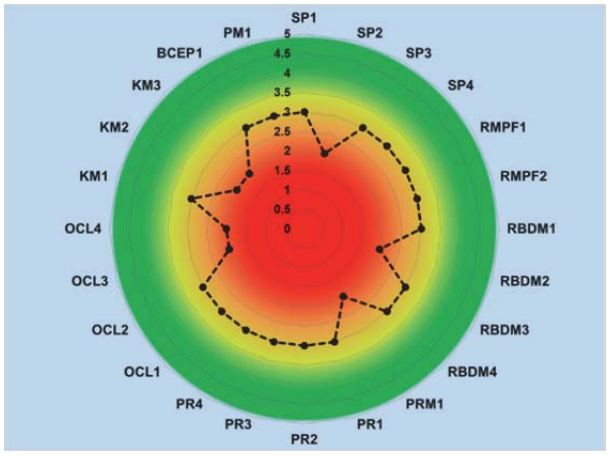
Organisation 3



Organisation 4



Organisation 5



Organisation 6

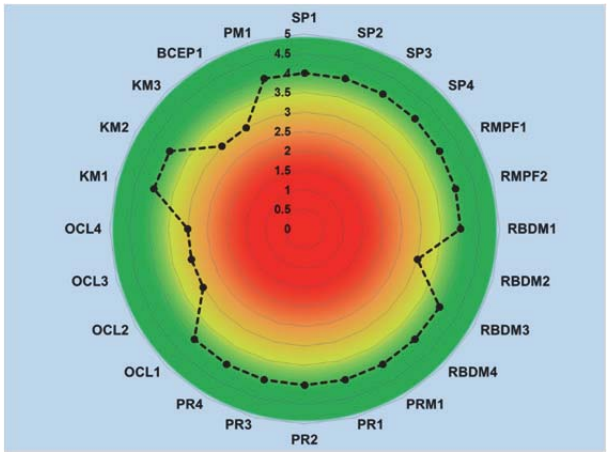
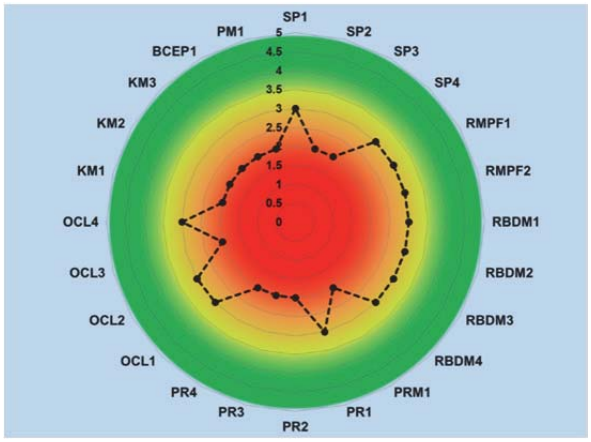
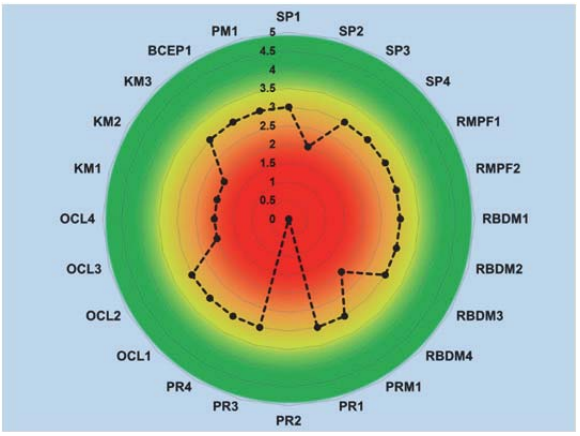


Figure 4.3: Individual findings for Organisations 1-6

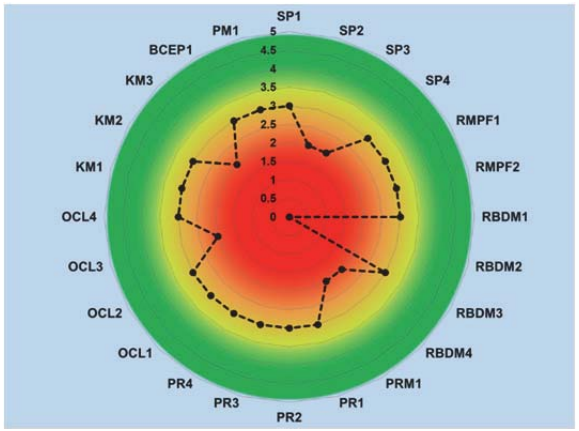
Organisation 7



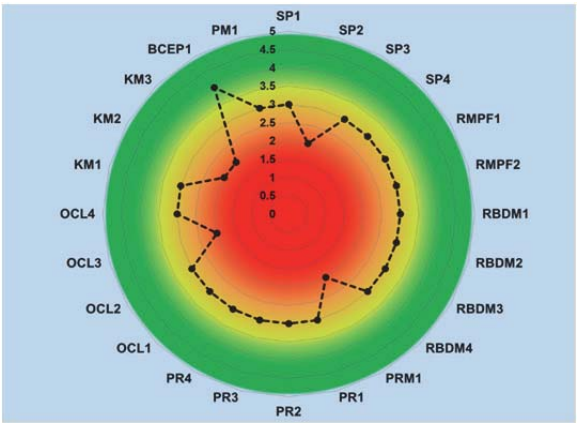
Organisation 8



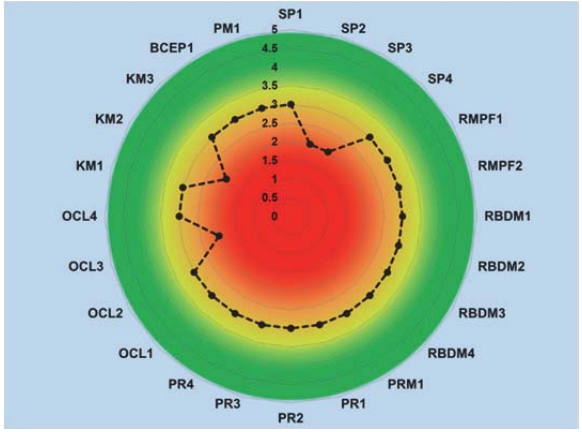
Organisation 9



Organisation 10



Organisation 11



Organisation 12

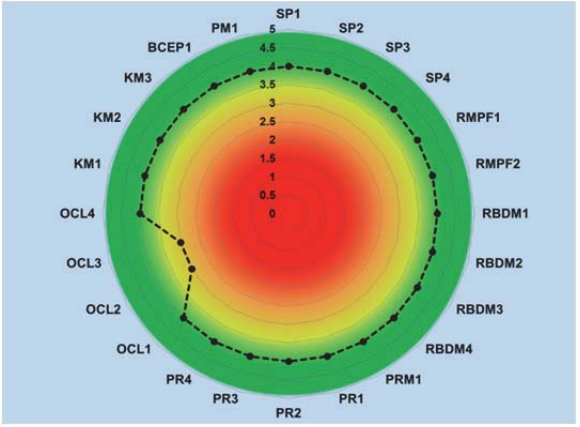


Figure 4.4: Individual findings for Organisations 7-12

Organisation 13

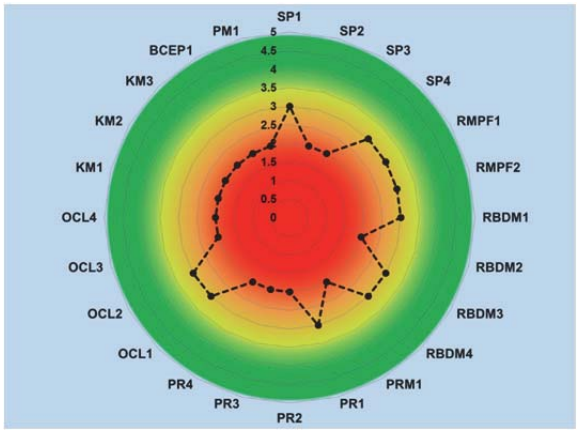


Figure 4.5: Findings for Organisation 13

4.3.2 AGGREGATE OF ALL ORGANISATIONS

Figure 4.6 shows the average maturity score of the organisations ranked from highest to lowest. All the organisations assessed score well above a maturity level of two, and three organisations in particular score above 3.5. Bear in mind that this is the average score across all the criteria and components for each organisation and there will be some variation between criteria and components for each organisation. The average maturity is just an indication of where they are on the journey to risk management excellence.

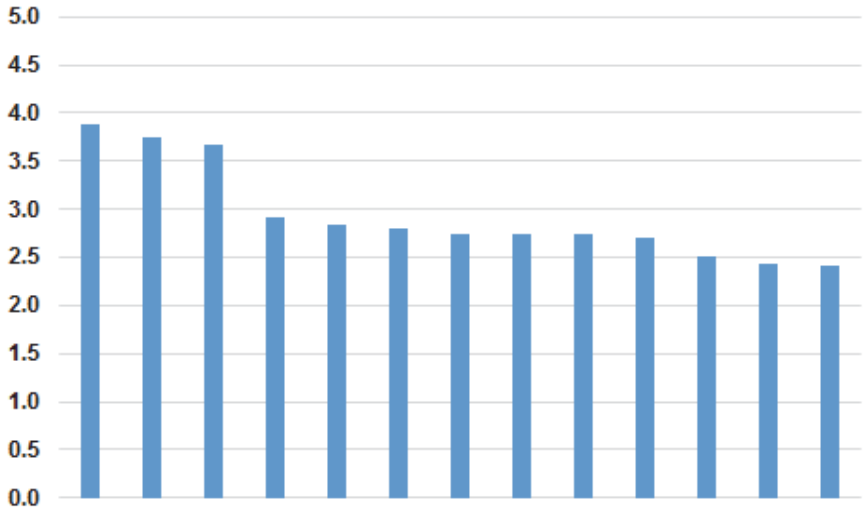


Figure 4.6: Average organisational maturity scores

Figure 4.7 shows the average score for each component. The components highlighted in green are those that on average are above three in maturity and are typically being undertaken in a structured and managed manner. The components highlighted in red are the ones that are on average less mature and are being undertaken in a basic or initial manner.

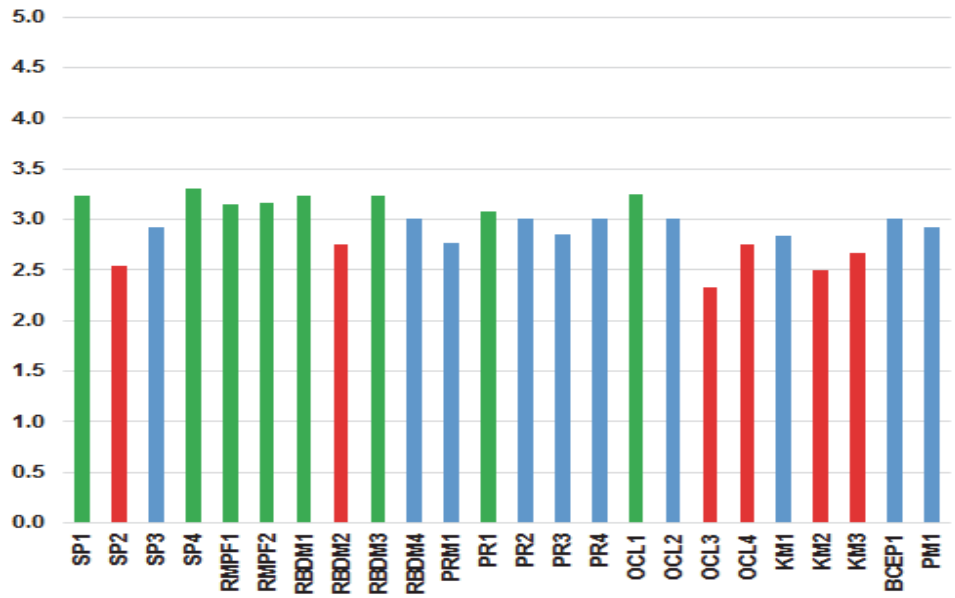


Figure 4.7: Average component maturity scores

4.3.3 STRATEGIC PLANNING

Strategic planning is primarily concerned with the consideration of risk and opportunity in strategic business activities. This criterion examines how organisations identify and communicate strategic objectives and how they identify the risk appetite and tolerance they are prepared to take in pursuit of the objectives. It also looks at the overall alignment and line of sight between strategic objectives and business activities, and how organisations undertake strategic risk assessments.

The identification and documentation of strategic objectives (component SP1) scored an average of 3.2. It was observed that all municipalities have strategic objectives that have been well documented in Integrated Development Plans (IDPs) and which have line of sight through their respective Service Delivery and Budget Implementation Plan (SDBIPs). Both these plans are a legislative requirement as described for by the Municipal Systems Act of 2000 and the Municipal Finance Management Act No. 56 of 2003 respectively. At a water and sanitation departmental level within a municipality the identification of objectives varies with some relying entirely on the SDBIP, whilst others have a defined strategy document, or include objectives in the Water Services Development Plan (WSDP) or regional master plans. Communication of the objectives and line of sight largely stopped at a mid-management level with mixed approaches below this level. Most municipalities relied on informal communication through managers while only a few had it embedded into performance management systems. Water Boards and municipal entities incorporated their objectives in

their corporate plan or business plan which aligns with their shareholder's objectives. Water Boards have communicated their strategic objectives to staff formally through performance contracts, personal development plans and performance management systems. The benefit of this approach is that each employee knows their contribution to the objectives and can see how their tactical activities cascade upwards to achieve these objectives.

The identification and quantification of risk appetite and tolerance (component SP2) scored an average of 2.5. All organisations indicated their understanding of the need to define risk appetite and tolerance. Only four organisations had formally identified and defined their risk appetite and tolerance informed by real quantifiable metrics and thresholds (such as variation in operating profit) and had integrated this into their risk decision making. Of the remaining organisations, most indicated their intention to develop risk appetite and tolerance in the near future as they mature in their capabilities. Most municipalities stated the challenge in defining risk appetite and tolerance, particularly as they are service delivery driven and therefore in many cases the appetite for risk is zero. Most organisations stated that risk appetite is mainly perceptual and based on informal guidelines developed by senior management and is seldom quantified in any financial way.

All organisations undertook strategic risk assessments, and as a result component SP4 scored highly at 3.3. **Figure 17** shows the frequency of these assessments. The approach to strategic risk assessments was typically formalised and defined in the risk policy or framework and the process was usually driven by the enterprise risk manager. The methodologies used varied, with the majority using expert judgement at a workshop or meeting involving senior management. **Figure 18** shows the most commonly used methodologies. Consultation during these assessments was mostly internal and up to the level of mid-management, with few engaging with external stakeholders and lower level employees. The outputs of the assessments were entered into a strategic risk register and in some cases these strategic risks were communicated in annual reports.

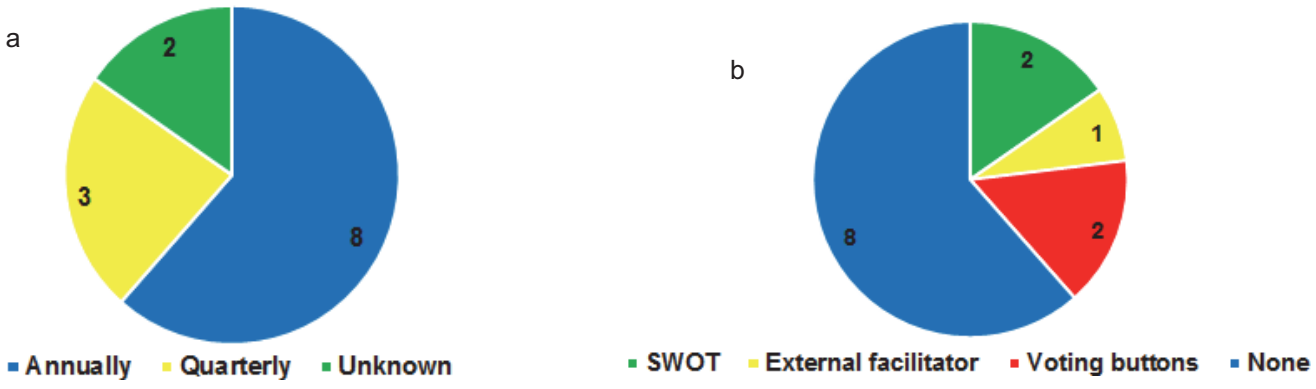


Figure 4.8: a) Frequency of the assessments and b) Commonly used methodologies

4.3.4 RISK POLICY & FRAMEWORK

A documented and communicated risk management framework that is underpinned by a sound risk policy must be in place to define and set out the processes and procedures, methodologies, responsibilities, communication and decision making structures for risk management. The characteristics of the policy and framework and the extent to which it is integrated into the organisations management system will determine how effectively risk is managed. The risk management framework needs to be at an enterprise level. Enterprise risk management is a broad based application of risk management in all functions and activities of the organisation. This criteria examined the extent to which a policy or framework had been developed.

All organisations were observed to have a risk policy and either a risk framework or strategy as shown in components RMPF1 and RMPF2, both with an average score of 3.2. Some organisations also had an implementation plan. The quality of these documents varied, with some being very comprehensive and others including only some high level points. Most of the frameworks identified key risk management roles and responsibilities and the type and frequency of risk activities, however these definitions were at a strategic level for example defining the roles of the risk committee or the internal audit function. Only a few of the more comprehensive frameworks defined roles and activities to lower levels of the organisation. Furthermore these comprehensive frameworks also defined the risk methodology including the criteria and processes followed. In some cases consequence criteria were aligned to strategic objectives for example customer, environmental or reputational. Most made reference to specific guidelines including King III, ISO31000 and the Treasury Risk Management Framework.

These documents were formal documents and there were formal processes in place where they are updated, reviewed and approved by various oversight committees for example the risk committee, audit committee, governance committee, board or council. For both the municipal entities it was noted that their risk policy and framework was aligned to their respective municipality policy and framework. Communication of the policy and framework varied yet all recognised the importance of good communication, with one organisation saying *“internal communication is very important to make all staff aware of the policy and procedures and we will be holding a series of roadshows over the next year to do this”*. A few organisations widely communicated the documents through workshops and meetings, and made it available to all employees on the intranet and in the public domain through their website. Some only formally communicated it to management which then cascaded the key components down to their teams through informal communication. Some organisations only made it available to employees on the intranet and it was unavailable in the public domain. Very few organisations formally communicated these documents to teams on the ground.

4.3.5 RISK BASED DECISION MAKING

Risk based decision making is concerned with using an assessment and understanding of risk as an input into decision making. Risk must be a central part of all decision making, at all levels in the organisation, from

strategic through to tactical, with decision making structures and processes defined. Asset management decision making in particular must find a balance between cost, performance and risk.

Component RBDM1 scored an average of 3.2. All organisations had various weekly or monthly internal committees, forums and meetings that facilitated decision making within departments and teams and between departments but not all were formally defined or documented. Cross functional decision making was better within departments rather than between departments. In most cases the risk framework identified key risk decision making structures and processes but these typically focused on strategic structures and processes at an enterprise level. At a departmental level various management meetings occurred but most of these were not formally documented or captured in a standard operating procedure. All organisations indicated that they took risk into account when making decisions but it was seldom considered in a formal manner or documented as such. An exception to this was the risk meetings, where formal risk decision making occurred. These meetings were attended by departmental management with the frequency of these meetings defined in the risk framework or strategy, the majority being monthly or quarterly. In many cases the enterprise risk manager attended these meetings and where this did happen it ensured consistency and allowed for interdependencies between departments and teams to be identified and captured. In this example the risk manager played an important role in breaking down silos between departments. An example one organisation gave was a water quality risk in the water and sanitation department is a major contributing factor to a risk in the health department. They had recognised these interdependencies and had developed a mechanism to manage these through the risk meetings and risk registers.

The routine use of risk based tools and methodologies (component RBDM2) scored 2.7. Water safety planning and wastewater risk abatement planning were the two primary methodologies used at an operational level to assist with the identification and management of risk. One organisation said *"the blue and green drop requirements have really highlighted to us the value in following risk based approaches, we now have much better quality drinking water and wastewater effluent and fewer incidents compared to six years ago"*. The benefits of the blue drop and green drop programmes cannot be overstated. However water safety plans and wastewater risk abatement plans are specifically focused on water quality and effluent quality and therefore are quite narrow in their focus. Very few other risk based tools were routinely used and organisations relied heavily on engineering judgement to make decisions. Most of the municipalities rely on factors such as asset age, remaining useful life, condition and performance as indicators of when an asset might be likely to fail and therefore when to maintain, refurbish or replace an asset. There is little consideration of consequence of failure and very few organisations used an assessment of both likelihood and consequence together with cost of the consequence to make asset management decisions.

Most organisations undertake some form of cost benefit analysis however few of the approaches consider the cost of risk or the benefit of risk reduction. As a result it's unlikely that scarce resources, particularly budgets, are being spent optimally as the prioritisation of investment does not fully consider risk. Most organisations have recognised that this is an area they need to improve on in the future to better integrate risk into tactical decision making. A notable exception to this are two organisations that undertake an asset management approach to the way they manage assets. Both these organisations have defined and documented methodologies that do consider risk in their asset decision making. One of these organisations

stated *"we put a lot of effort in reducing the reliance on expert judgement by having manuals and guidelines and using tools to assist our asset management activities".*

Integration and consultation (component RBDM3) scored 3.2 as most organisations did have some mechanisms in place to make integrated decisions and did consult with a variety of stakeholders. Supply chain risks were mainly considered in relation to the water value supply chain, particularly with Water Boards supplying municipalities with water. In the cases where municipalities bought water from Water Boards, most had monthly or quarterly meetings to discuss common issues. Water Boards similarly met with the Department of Water and Sanitation. Internal supply chain risks were usually the responsibility of the supply chain or finance function. An issue that was increasingly highlighted in municipalities was the procurement process. In some cases the water and sanitation departments had little control over who their suppliers were and the specifications of the products because the municipality already had suppliers established. Where such risks are suitably managed it was when there was senior management cross functional meetings that both the water and sanitation department and the supply chain department attended.

Climate change was regularly brought up at most of the organisations' management meetings and was a topic high on the agenda **(Figure 4.9).** For some organisations, it appears as a risk on the risk register and some had commissioned studies to understand the impact it will have on their organisation. In some municipalities climate change risks were considered on a municipal wide basis and focused on energy efficiency and carbon emissions (the effect the municipality has on climate change) and were not specifically related to water scarcity or flooding (the effect climate change has on a municipality).

Figure 4.9: Do you consider climate change risks?

The consideration of external risk interdependencies for most organisations was primarily limited to energy security, in particular the impact of Eskom; with the majority of organisations having purchased generators to mitigate this risk. The majority of organisations assessed risk interdependencies on an ad-hoc basis and not through a formal process and in some cases reactively after an incident has occurred. Recent emerging risks associated with Eskom and power outages were observed as a catalyst for organisations to improve the way they identify risk interdependencies. Most of the municipalities had meetings on a district level or with

stakeholders from the wider area, for example provincial government, catchment management agencies (CMA) or water user associations (WUA). This appeared to add value to the functioning of the organisations as they were aware of more regional risks and the interdependency of organisations in the area. These wider district initiatives were often driven by the district municipality or provincial government. However in some cases this open and collaborative approach is not successful, with one organisation stating *"we do talk to other (external) organisations but we usually don't get much of a response, in other words the dialogue is open but it is not very productive".* This demonstrates that collaboration requires involvement from all parties and can often only happen when a more senior party dictates it. There was good sharing of risks within the water supply value chain. Where this did happen certain risks were shared with stakeholders for example a Water Board sharing a water quality risk with a municipality. No organisation openly shared their risks with other external organisations.

Health and safety was taken seriously by all the organisations. A number of the larger organisations had a team of health and safety representatives within a Safety, Health, Environment and Quality (SHEQ) department. Hazards and risks were routinely identified through site inspections and audits, and these were managed formally and discussed regularly at management meetings.

4.3.6 PROJECT RISK MANAGEMENT

The implementation of projects results in change and therefore comes with risks. Organisations must have appropriate processes, procedures and systems in place to manage risks associated with projects throughout their lifecycle. This criterion examines the procedures and processes used to identify and manage project risks. Five organisations had an enterprise wide project management team that was responsible for managing large capital projects **(Figure 4.10)**, but in nearly all cases it was understaffed and oversubscribed and could not adequately assist the water and sanitation department with managing projects and related risks. It was up to the water and sanitation department to manage smaller capital projects. Few organisations had defined project risk management processes and procedures.

Figure 4.10: Do you have a project management team?

It was observed that for those projects not being managed by the project management team, organisations relied on the contractor or consultant to manage project related risks using their own processes and procedures. These procedures were in most cases different to the way the organisation managed risks and thus there was little alignment to the general business risk management processes. All organisations considered project risks at initial stages or during the feasibility study but the consideration of project risks stopped at the point when the project handed over to the contractor. Project risks were captured on dedicated project risk registers and rarely made it onto the business risk register although in some organisations there were mechanisms in place to have a project risk on the business risk register, particularly if it was a strategic risk with reputational or financial implications. A few organisations undertook post project reviews through a formal documented approach.

4.3.7 PEOPLE & RESOURCES

People and resources in an organisation are the most important factors determining the success of risk management and governance. The right people with the right skills, attitude and behaviour need to be in place, they need to be trained to do their jobs and provided with the appropriate resources, tools and remuneration; and they need to be well managed. People and resources component PR1 scored an average of 3.1.Most organisations assigned risk related roles and responsibilities in their risk management framework or strategy. Additionally, risk roles were often outlined and captured in job descriptions and in a few standard operating procedures (SOP). Some organisations had identified key performance indicators (KPIs) for people with risk roles; however this was usually for senior management only. All the organisations assessed had an enterprise wide risk manager and the larger organisations have dedicated risk teams that worked across the organisation. **Figure 4.11** shows the people resources available.

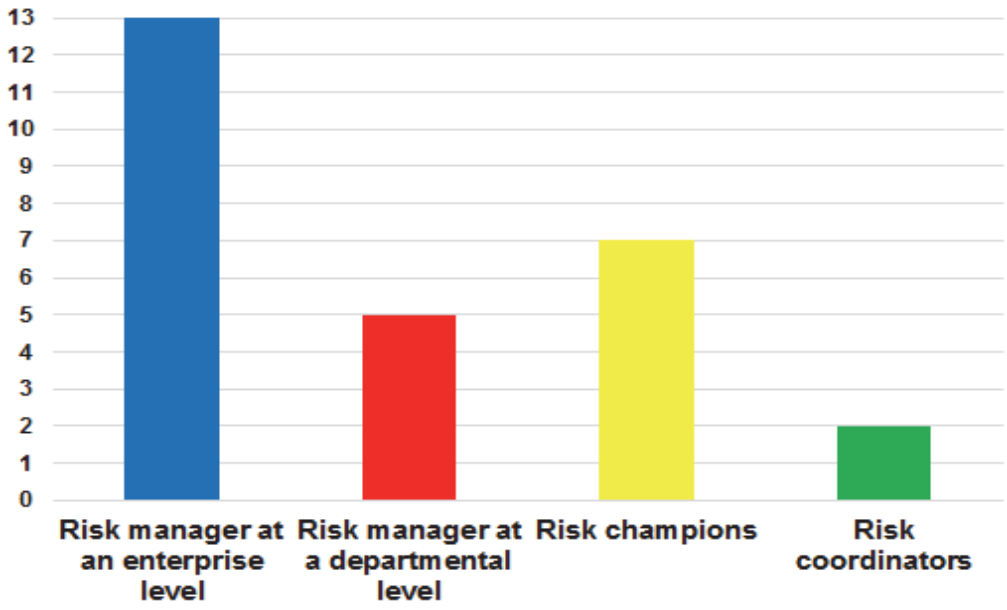


Figure 4.11: People resources available

The majority of organisations had formal dedicated risk champions or risk coordinators and most fulfilled this role over and above their day job. In the smaller municipalities the role of risk champion was usually the responsibility of a senior manager. In most of the organisations that had just one risk manager at an enterprise level, the lack of budgets and resources was identified as an issue that was hampering the improvement of risk maturity and capability. One organisation in particular indicated that the lack of budget to fulfil key roles was their biggest risk.

Most of organisations had formal training and development programs in place and employees could request training where they felt it was necessary. However, a common theme that emerged was that most of the training and development programs functioned better for lower level employees. Also the assessment of training needs was usually informal and undertaken between the employee and their manager, with very few organisations carrying out structured skills benchmarking. Risk specific training was usually provided by the risk team or the risk manager. In the organisations that didn't have risk training established, the risk manager recognised the need for it but they could not implement it as the risk team was under staffed. In many of the municipalities, senior management had to undertake compulsory training on the Municipal Finance Management Act, a component of which was specifically about risk. One organisation was a corporate member of IRMSA and they used the IRMSA training and development programme to inform the internal training they carry out. Another organisation encouraged their risk champions to complete the Treasury eLearning module on risk management.

Risk treatments and controls were always funded from existing capital or operational budgets. The approach to developing budgets was mixed with most of the organisations using historic budgets to inform future budgets and only a small number of organisations routinely identifying risks that could inform the future budgets. Risks were observed to informally inform the budget process but the extent to which this happens and the mechanism through which it happens was usually unclear. All organisations indicated that there were reprioritisation processes in place if budget was needed unexpectedly to cover unforeseen events or new risks that have materialised.

4.3.8 ORGANISATIONAL CULTURE

Organisational culture is concerned with embedding a culture of risk into the collective mind-set of an organisation. Crucial to this is the role of leadership in setting the right tone from the top, leading by example and driving and managing behaviours and performance of teams and individuals. An organisation must take human and cultural factors into account and recognise the capabilities, perceptions and intentions of internal and external people that could facilitate or hinder achievement of organisational objectives. Senior management and leadership must foster an enabling environment that supports and encourages a risk management culture based on openness, transparency, collaboration, awareness and mindfulness. The organisational culture is the foundation of risk management, providing the underpinning behaviours, discipline and structure that influence how strategy and objectives are established, how activities are planned and executed and how risks are identified, assessed and acted upon. This criteria was difficult to measure and to get a deeper understanding of an organisational culture will require a more detailed analysis.

All the organisations indicated there was a strong tone from the top and senior management, and it was widely held that this buy-in from management drove risk management activities. This is reflected in component OCL1 with an average score of 3.2. In most of the municipalities, the municipal manager and executive management team as well as the mayor supported risk management. One organisation felt that the tone from the top was to meet regulatory compliance rather than to deliver value and resulted in occasions where departmental mangers were nervous at making decisions. Another organisation felt that even though management supported risk management, it made no difference in the tactical and day to day activities of the department as a number of risks had been identified on the strategic risk register yet there was very little tangible benefit to the department as a result. In both these examples it is important for these organisations to ensure that risk management activities do not become a tick the box exercise for compliance purposes. There is considerable value in risk management when it is used to help make better decisions, rather than just comply with regulations.

Employees at operational levels and on the ground were observed in most organisations to have a pride in their work and an understanding of their contribution; this was primarily facilitated through communication from departmental managers and importantly team leaders, supervisors and process controllers. One organisation reiterated the importance of good management and stated *"the guys at the plant have a strong culture and pride in what they do, they have been empowered to own the processes and make decisions themselves, something that management has been encouraging".* Most organisations noted that although these employees engage in risk management activities they are not always aware of the exact terminology and would not necessarily define it in such a way. Communication about the benefits of risk management was not explicitly done but done implicitly as it was considered a by-product of effective risk management activities. Where organisations had risk champions and coordinators, it was broadly felt that the risk culture was more mature and developed.

Component OCL3 scored fairly low with an average score of 2.3 as very few organisations follow a structured approach to change management. Change results in uncertainty and therefore risk, and as such it must be undertaken in a structured manner and with a consideration of the risks involved. This includes any internal and external change, such as a new operating procedure, an asset replacement, legislative changes or an organisational restructure. Only two organisations had formal change management processes in which risks were considered and the majority of the organisations managed change as it happens and on an ad-hoc basis with limited consideration of risk. The change is usually focused on the technical aspects and undertaken by the technical team facilitating the change, for example a new IT programme would be managed by the IT department. Consequently other aspects would be neglected or only considered towards the end of the project, such as the people, cultural and behavioural aspects. One organisation had spent a considerable sum of money and time implementing a new IT programme yet as there was little formal change management, only 20% of users were actually using the system regularly, with the rest continuing as before. Most organisations recognised this as an area needing improvement.

Component OCL4 was also low scoring with an average score of 2.8. Generally, most organisations had ad-hoc approaches to the way they learnt from past events. External and internal audits played a large role in fostering continuous improvement and learning from past events. A few organisations reviewed and learnt

from past incidents according to the requirements of their quality management system ISO9001. Near misses relating to health and safety were monitored the most. Post project appraisal and root cause analysis was undertaken by a few organisations only. Only a couple of organisations, most of which were Water Boards, undertook employee satisfaction surveys on a regular basis and used the findings of these to improve things for employees. The celebration of success was largely limited to celebrating blue and green drop scores through newsletters or websites, and in some cases, through a function. Most municipalities had municipal wide awards ceremonies where successes are celebrated. A few organisations did not celebrate success at all. Only two organisations made the explicit link between tying rewards to performance contracts and KPIs.

4.3.9 KNOWLEDGE MANAGEMENT

Knowledge is an important commodity that can create a competitive advantage for organisations that use it well. This criterion was concerned with the establishment of an appropriate risk knowledge management system to enable the effective and efficient collection, storage, reporting and communicating of risk data and information. It also looked at how they use the system to report on risks to inform day to day decision making and how they manage and retain institutional knowledge. This is particularly important in the context of skills shortages and an aging workforce.

The risk knowledge management system for the majority of organisations was Excel spreadsheet based rather than bespoke software. **Figure 4.12** shows the various systems used.

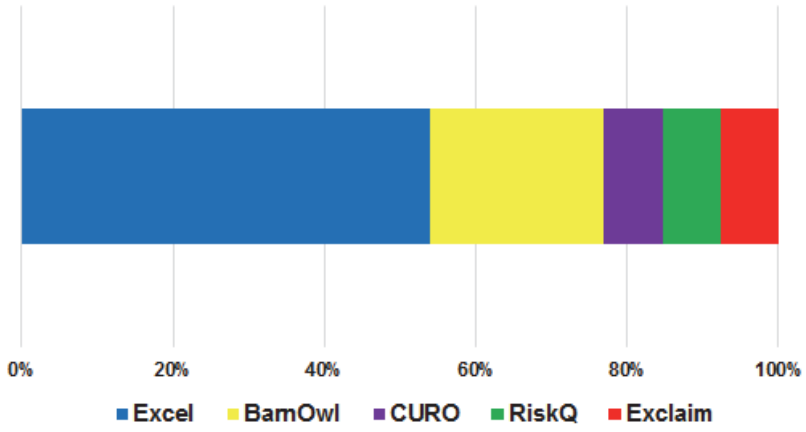


Figure 4.12: Risk knowledge management systems

In all the organisations there were operational risk registers and strategic risk registers. Generally each department would have its own operational risk register, which would then cascade upwards to a single strategic risk register that would cover all the departments. The different departmental registers were all developed using the same format and the risk criteria. Access to the risk register was limited to either risk champions, the risk managers or senior management. In a few municipalities the registers were held in a common network where it could be viewed by risk owners or risk control owners but not edited. This limited access was the primary way to ensure quality control and to reduce the chance that risks would be

manipulated. In one municipality, there was no control over access and the risk manager relied on changes to be communicated to them.

Risk reporting capabilities were observed to be quite limited as shown by component KM2 with an average score of 2.5. This was particularly relevant for those that used spreadsheets. One organisation mentioned *"it is very difficult to get anything meaningful out of a spreadsheet other that a prioritised list, and it takes a lot of manual manipulation to generate useful reports".* They had no capability to easily monitor change in risk over time or risk interdependencies unless these were manually identified. Bespoke risk software has more powerful reporting capabilities such as heat maps, monitoring of residual risk and monitoring how risks change over time. The reports generated through risk registers were typically for management and committee meetings and the registers were not usually used to inform operational decisions. One organisation stated that *"the risk register is of no value to the operational teams, it is there for managers to know what risks they have, we use water safety plans to manage operational risks, not the risk register".*

Institutional knowledge (component KM3) scored an average of 2.6. All of the organisations had SOPs in place but not for all procedures. Very few organisations had SOPs in place for management procedures. One organisation stated that *"the planning process is not documented anywhere, everyone just knows what to do"*. It is important that all processes, including managerial, are documented and communicated to ensure consistency and continuity. All organisations relied on SOPs to capture institutional knowledge, yet a number of organisations did not consult with the operational teams when developing the SOPs. The Water Boards engaged in succession planning through a formal documented process. A common theme amongst municipalities was the difficulty in engaging in succession planning as posts need to be advertised externally so people cannot be prepared for a specific post. Succession planning was raised as a major risk in most of these organisations because of an ageing workforce.

4.3.10 BUSINESS CONTINUITY & EMERGENCY PREPAREDNESS

Emergency preparedness is about organisations having plans in place that manage the immediate aftermath of an emergency and disaster. Business continuity is about organisations having plans to allow them to continue operating after an emergency or disaster. This criterion examined the extent that organisations has established, communicated, tested and resourced business continuity and emergency plans. All the municipalities had municipal wide disaster management plans established, often in conjunction with the district municipality. Most organisations had site specific emergency response plans or incident protocols. Only three organisations had established business continuity plans in place, although four have identified this as a requirement and are in the process of developing these. In some cases, there were pockets of business continuity plans across the organisation but no consistent and consolidated approach. There was a mixed approach to the communication and testing of the plans. A few organisations routinely tested the plans, at least annually, while others undertook ad-hoc testing or no testing. Business continuity plans and emergency response plans were observed to be better in Water Boards compared to municipalities.

4.3.11 PERFORMANCE MANAGEMENT

Performance management is about how organisations assess the effectiveness of the risk management policy and framework and all the associated risk management activities. Evaluation of risk management effectiveness will enable deficiencies and improvements to be identified. Monitoring and reviewing are an important part of the performance management system. Monitoring and reviewing activities should focus on evaluating whether allocated responsibilities are being executed effectively; treatments and controls are producing the desired results and a positive correlation exists between improvements in the risk system and organisational performance. Organisations should periodically evaluate the value add of risk management by measuring outcomes against KPIs aligned to the overall objectives of the organisation. Organisations should use the performance management system to incrementally improve their risk management maturity.

Figure 4.13 shows the common approaches to performance management. All organisations relied on their internal audit function to provide a check on their risk system. Internal audit is an important part of risk governance oversight. Furthermore, some organisations were assessed by National Treasury or provincial government.

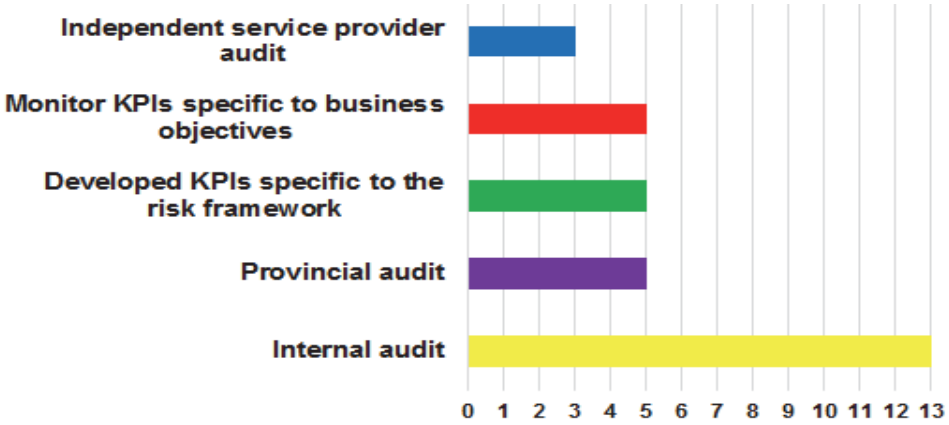


Figure 4.13: Approaches to performance management

Five organisations had developed specific KPIs that related to the risk policy and framework and these were being monitored to check the effectiveness of the policy and framework. This was evident in the organisations with established risk teams with the resources to do this. Examples of such KPIs include risks above the risk appetite or tolerance, actions not completed but beyond the completion date and how residual risk changes over time. Many of the organisations indicated that they relied on soft indicators to measure performance or that performance was monitored indirectly through the achievement of business objectives. If a business objective is being met then the risks associated with that objective are being managed. Risk control effectiveness was formally assessed and recorded by eight organisations. This was always a perceived effectiveness based on expert judgement and was recorded in the risk register. The controls and their effectiveness were then audited and tested either by the risk manager or the internal audit team, usually quarterly or annually. Most organisations informally considered the risks that controls introduced. Most organisations identified that there was opportunity for improvement in the way they manage performance.

4.4 CONCLUSION

The findings of the assessment have provided an interesting insight into how these organisations understand and manage risk. The management of risk is a requirement of legislation and as such all the organisations assessed undertake risk management in some form. The overall average maturity of the organisations varied from 2.4 (initial) to 3.9 (managed). The results suggest that the sample included organisations that are already practicing reasonably good risk governance. This is supported by the fact that all the organisations had an enterprise wide approach with a risk manager, risk policy and risk framework. Furthermore the organisations had established corporate governance structures in place such as various oversight committees. With these factors established, the initial building blocks of good risk governance are in place.
Most of the smaller municipalities and municipal entities were at a maturity level between two and three. This suggested they have recognised the need for and benefits of risk governance and established at least basic processes and procedures to identify and manage risks.

In some cases organisations have developed a managed approach that exceeds regulatory requirements and extends across core business areas. There is some documentation that details certain procedures, responsibilities, criteria and methods relating to risk governance and basic audit mechanisms verify compliance. There is some cross functional and external consultation and adequate resources in place. However organisations at this maturity level are still vulnerable to change and uncertainly and are still reactive in some management approaches. The Water Boards and the metropolitan municipalities were observed to have a higher maturity level compared to the small municipalities and municipal entities. Water Boards and metropolitan municipalities are better resourced and have larger teams, including a dedicated risk team at an enterprise level, and also risk champions and coordinators within various departments.

As organisations move from a maturity level of three to four they start to embed their risk governance activities at an enterprise level with processes, procedures and systems in place to work across all functional boundaries providing an integrated response to events. At this level of maturity systems and performance metrics are in place to evaluate the effectiveness of the risk management system, risk knowledge is actively used to improve business processes, inform decision making and provide assurance. Key stakeholders are consulted and involved in decision making and a risk aware culture is becoming established.

The challenges of implementing successful risk governance approaches in the water sector are well documented. Literature indicates that the journey is demanding and can take up to 15 years, and requires strong leadership; a clear vision; a policy, framework and implementation plan; commitment and resources to implement the plan; good governance structures; open and transparent reporting mechanisms and regular engagement with all stakeholders. Moreover it indicates that a culture of risk needs to be deeply embedded in the organisation, which involves changing the mind sets of employees and other stakeholders. The findings of the assessments have shown that most of these factors are in place or are being established. This is a promising finding as it shows that these organisations have all started their journey to risk governance excellence.

CHAPTER 5: CONCLUSION & RECOMMENDATIONS

5.1 CONCLUSION

South Africa provides a unique, dynamic and challenging physical, political and socio-economic environment in which to manage the risks associated with the provision of water services. The complex set of risks, interdependencies, multiple risk driver and unpredictable characteristics of drinking and wastewater systems in South Africa requires risk management and governance to be at the heart of what a water service authority or provider does.

Historically in South Africa there has been an emphasis on operational risk management activities related to water quality and quantity, such as the Blue Drop, Green Drop and No Drop programmes and water safety and wastewater risk abatement planning. These have provided considerable benefit and resulted in a marked improvement in water and effluent quality. There is limited knowledge on risk governance practices in the South African water sector or the level of risk governance maturity of water service authorities and water service providers. The better management and governance of risks in the water sector highlights an opportunity to facilitate solutions and ultimately to secure the efficient provision of water services in South Africa. To facilitate such an approach, a risk maturity model is required to assess risk capabilities and to bring about improvements.

The risk maturity model was developed to assess risk management and governance practices of an organisation against a predefined standard. This risk maturity model is a tool and an approach to progressively establish a desired maturity level. The model draws on the principles of capability maturity modelling, other risk maturity models and various international and local standards and guidelines. The tool consists of five maturity levels, each of which describes the characteristics of an organisation. There are nine criteria and a further 24 components that are assessed and then scored against the maturity levels. The choice of five levels of maturity gave a broader range of maturity levels, thought to be more applicable to the South African context. The nine criteria take into consideration a broad range of elements required for risk management such as strategic planning, risk based decision making, organisational culture and leadership, knowledge management, business continuity and project risk management.

The risk maturity assessments provided an interesting insight into how these organisations understand and manage risk. The assessments demonstrated that all the participating organisations undertake risk management, primarily in the form of routine risk assessments, water safety and wastewater risk abatement planning. Most organisations that were surveyed had established some risk governance practices and are moving towards a governance approach to risk at an enterprise level. All organisations had recognised the importance of risk appetite and tolerance, with only a few having formally defined this using quantifiable measures and using it in risk decision making. Most organisations used a perceived value that is not

quantified. Methods for making risk based decisions were observed to be primarily through water safety planning and wastewater risk abatement planning, while very few other risk based tools and methodologies were routinely used to inform tactical decision making, particularly for capital investment planning and prioritisation of interventions. In most of the organisations that had just one risk manager at an enterprise level, the lack of resources was identified as an issue that was hampering the improvement of risk maturity and capability. The risk knowledge management system for the majority of organisations was Excel spreadsheet based rather than bespoke software. This resulted in some data quality issues and also limited the reporting capabilities of these organisations. All organisations identified the loss of institutional knowledge as a major risk, yet it was found that only a few have formal successions planning in place and many institutions have not captured all operational and managerial procedures in a document.

The key insights that emerged from the study relate to the value of strong and inspired leadership to guide and motivate employees to undertake risk management. Long term leadership support is critical, as the journey to excellence can be 15 years. Moreover leadership works to build a risk aware culture in all employees. Another key insight is the value of strategic and risk based decision making to an organisation, where decisions are based on a quantification of risk rather than a perception of risks. A robust risk policy, framework and implementation plan can assist to this end in ensuring that risks supports decision making, rather than being a tick the box exercise. Lastly the insights from this study have highlighted the significance of having skilled people in place to facilitate risk management, such as risk champions or coordinators, and the importance of cross functional working, both internally and externally

The results and key insights from this study are being used to develop a compendium of case studies highlighting good examples of risk governance in the water sector and a risk governance implementation guide. These two deliverables will hopefully provide some inspiration to water utilities to start their own journey to risk governance excellence and provide comprehensive information about how to establish a sound risk governance system.

5.2 RECOMMENDATIONS

From the key insights gained from the study, a number of recommendations have been identified that the water sector and individual organisations should consider to assist them on their journey to risk governance excellence:

General

1. The water sector needs to repeat this study ensuring a wider coverage of stakeholders are assessed, and in particular a sample of organisations that are known to be struggling with water and sanitation service delivery. Furthermore a broader coverage across all the provinces is needed. The support of the Department of Water and Sanitation, the Department of Cooperative Governance and Traditional Affairs and the South African Local Government Association is vital for this initiative to work.

Strategic Planning

2. Organisations need to define and quantify their level of risk appetite and tolerance and integrate these definitions into risk decision making.

Risk Policy & Framework

3. Organisations should ensure the risk policy and framework is well communicated and comprehensive enough to guide all risk activities at both an enterprise level and operational level. Furthermore organisations should consider having an implementation plan to support the implementation of the policy and framework.

Risk Based Decision Making

4. Organisations must document all managerial processes and procedures in a SOP or guideline. This will ensure consistency and continuity, and reduce duplication.
5. Organisations must consider using risk based tools and methodologies to inform tactical decision making, particularly capital investment planning and the prioritisation of interventions. Such tools must consider both the likelihood of an event and the consequence of the event.
6. The water sector needs to develop a standard guideline document that provides a consistent approach and methodology for risk based decision making and the primary tools available. The Common Framework for Capital Maintenance Planning (United Kingdom Water Industry Research, 2002) was developed in the United Kingdom for this purpose and was a seminal document that changed the way the water sector made decisions. The South African water sector could do with a similar document.
7. The water sector needs to adopt better asset management practices that are aligned to international best practice such as ISO55000 (International Standard Organisation, 2014). The definition of asset management is not just maintenance and a more holistic approach is required.
8. Organisations must establish mechanisms to formally consider external interdependencies through their supply chains and the water value chain. Energy security has been a catalyst for this thinking yet this is only one example of an interdependency.
9. National government and provincial government need to facilitate these cross functional forums.
10. Organisations must establish mechanisms to formally consider internal interdependencies between departments and teams. The risk manager could play an important role in breaking down silos between departments.
11. Organisations should consider how they could better integrate risks in the water and wastewater risk abatement plans and the risk register to facilitate improved reporting and decision making.

Project Risk Management

12. Organisations need to formalise and document their approaches to project management, which must include risk management. Risk must be considered at key points throughout the project lifecycle. The approach should be aligned to the organisational risk policy and framework.

People & Resources

13. Organisations should establish formalised skills benchmarking that is then used to implement appropriate training and development programmes across both operational and managerial staff.
14. Organisations should appoint risk champions or coordinators within departments and teams, and empower them to drive the risk agenda.

Organisational Culture & Leadership

15. Organisations need to formalise and document their approaches to change management, which must include the assessment of risk at key points throughout the change programme. The approach should be aligned to the organisational risk policy and framework.
16. Organisations need to develop and empower operational staff, particularly at a team leader, supervisor or process controller level, as these roles are very influential in developing a culture of risk mindfulness, safety and vigilance.
17. Organisations should establish mechanisms to formally capture learning from past events, both successes and failures, and use this to continuously seek to better their capabilities in the pursuit of best practice.

Knowledge Management

18. Organisations that use spreadsheets as their risk knowledge system should consider using risk software, or if this is not economically viable, then ensure their quality control is robust.

Performance Management

19. Organisations must identify KPIs specific to the risk policy and framework and have mechanisms in place to monitor these to check the effectiveness of the policy and framework, including the effectiveness of risk controls. Internal audit can provide a secondary assurance function.
20. Organisations must consider undertaking external benchmarking periodically to measure their maturity and determine where they are improving and where they still need to improve.

Since the water sector faces a myriad of challenges that threaten the provision of water services and in turn the social and economic stability of the country, risk governance is fundamental. This report provides stakeholders in the water sector with a deeper understanding of the theoretical underpinnings and practical approaches to improving risk governance and management. Furthermore, this research provides a basis for facilitating a stepwise improvement in the provision of water services in South Africa through a risk governance approach.

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