An RDI Value Framework

A framework toward empowering research institutions to deliver demonstratable value to their stakeholders

Volume 2: The development of the Framework and practical tools

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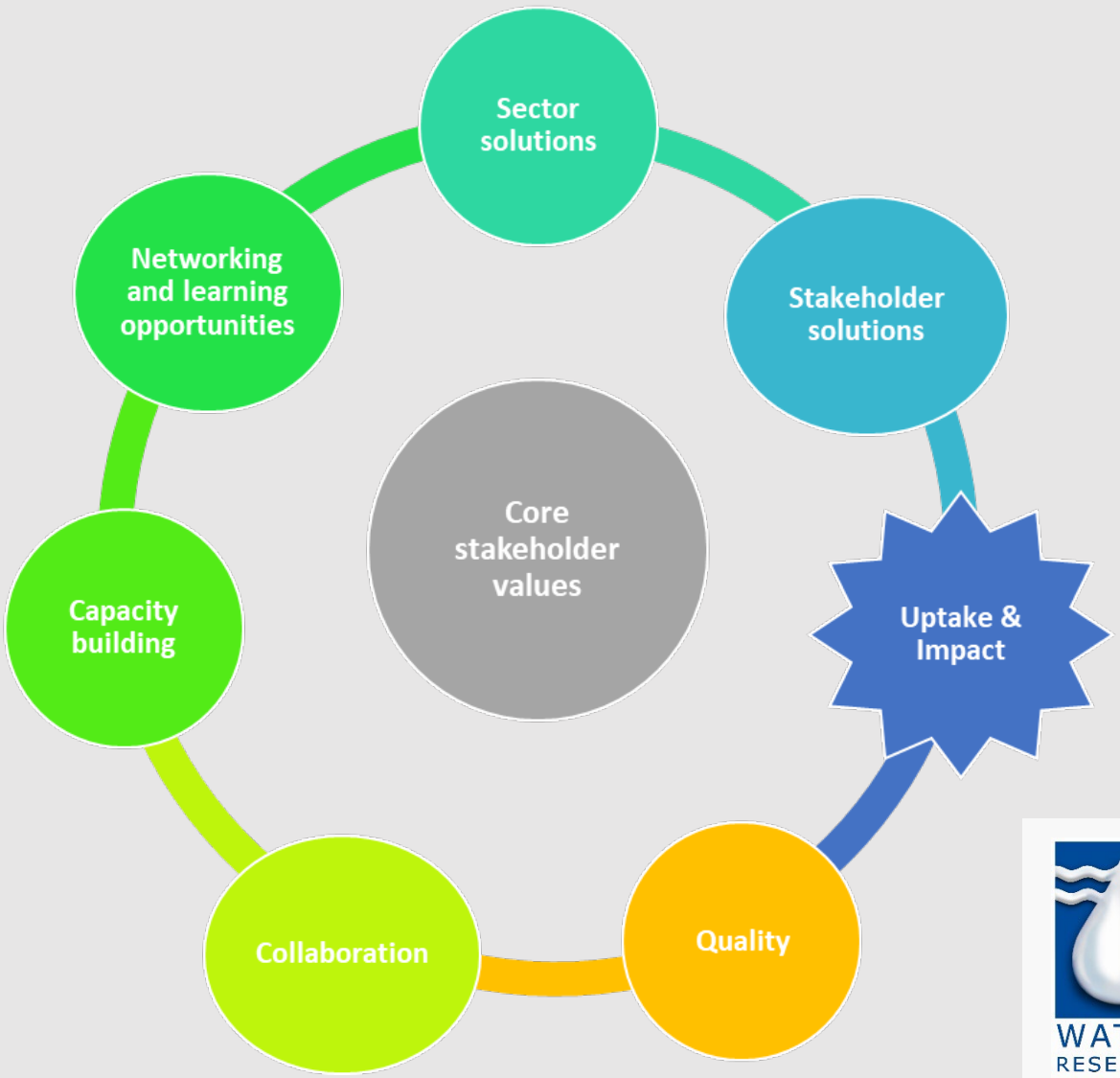

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Executive summary

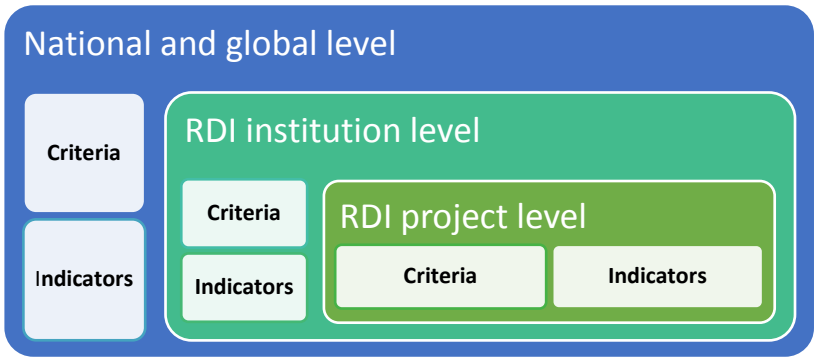
Globally, water research organisations grapple with the same challenge:

> *In some cases, research and innovation are conducted to produce new knowledge and innovations that are poorly, or not taken up by the water and sanitation sector or industries.*
> (Quote from Terms of Reference of this study)

The research team was tasked to address this challenge with the South African Water Research Commission (WRC) as a case study. The study forms part of an initiative of the Global Water Coalition (GWRC), of which the WRC is a member.

A comprehensive literature review provided the theoretical background. It found the following:

- The reviewed Research, Development & Innovation (RDI) frameworks set criteria for RDI outputs (and inputs) and identify associated indicators that the criteria have been met. Input criteria relate mostly to resources and other requirements for an environment that supports and encourages innovation. Output criteria relate to aspects like quality, relevance and what is perceived as the benefits of RDI (for example, socioeconomic or environmental benefits).
- Most of these RDI frameworks are evaluative, that is, the indicators are used to measure if, and to what extent, the criteria have been met. However, some RDI frameworks are facilitative in the sense that they assist projects or organisations to meet the criteria. For example, the Research Impact Toolkit, discussed in the literature review, is a facilitative RDI framework that includes mechanisms to actively plan for uptake and impact. It was interesting to note that the National Research Foundation has recently adopted a facilitating approach to impact realisation.
- The performance of individual research projects on RDI criteria and indicators can be aggregated to the level of the research institution, whose RDI outputs ultimately contribute to the national and global RDI indices, as the figure illustrates.



The research subsequently analysed the WRC's mission and vision statement, and annual reports, to determine how the organisation is structured to deliver value to its stakeholders. The research also summarised the findings of the stakeholder research that the WRC has done in the past.

These findings, plus the insights gained from the literature review, informed the first round of stakeholder engagements. Thirty stakeholders of the WRC, including project stakeholders from a sample of six WRC projects, were interviewed to understand what they perceive as the value of RDI and how they would describe the value that WRC RDI projects have delivered or not delivered to them.

The first round of stakeholder research found that the value that stakeholders ascribe to water and sanitation RDI is multifaceted and looks different for different groups of stakeholders. The research found overlaps in both value and indicators, but this overlap does not run across all representatives of a stakeholder group, nor does it run across all stakeholder groups.

Some stakeholder values, like sector solutions, are delivered, or expected to be delivered, at research project level; some at the level of the research institution (for example a mechanism to coordinate water research in South Africa); and some at national level (for example, regulatory and policy measures that support innovation).

Despite the diversity, seven core stakeholder values (see figure below) could be extracted and related to the literature.

Their associated indicators at national, institutional and project level could also be aligned with the literature. (It is acknowledged that for other members of the GWRC, the core stakeholder values might look different.)

However, the value or benefits which end-users and beneficiaries ascribe to water and sanitation RDI, and the associated indicators, were found to be project specific.

The next task was to develop a water and sanitation RDI framework for the WRC, based on these seven core values and the insights from the literature review and stakeholder research. Since this Framework must capacitate Project Leaders and Research Managers to unlock the full value of RDI projects for stakeholders, the research team called it an RDI Value Framework.

The draft Framework was presented to the GWRC during an online workshop on 20 January 2022.

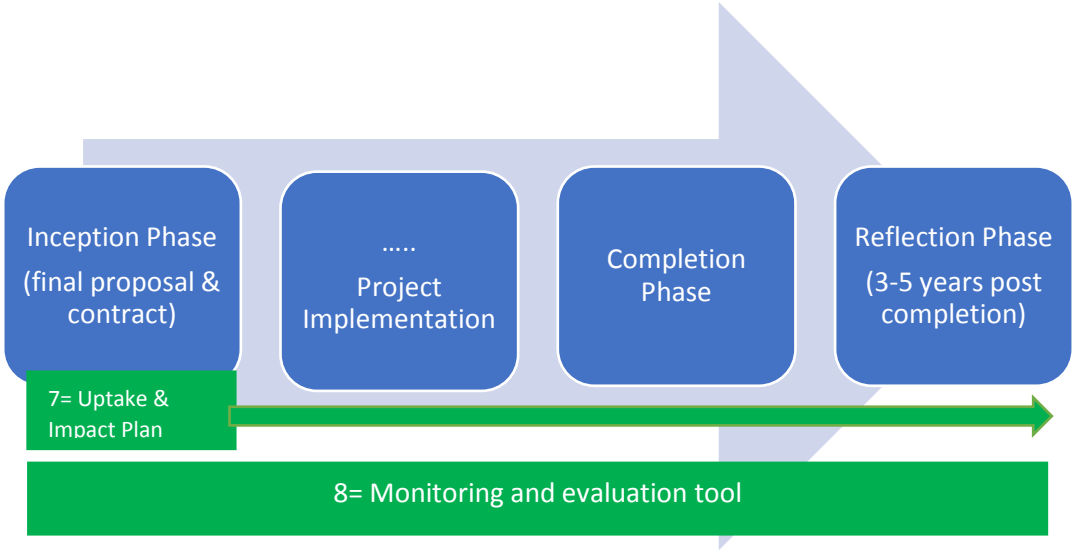
The guiding principles in developing the Value Framework were the following:

- Stakeholder value, as defined and described in the literature review, is the main pillar of the Framework, and it was also the starting point from where the Framework was developed.
- The concept that RDI can be planned to realise stakeholder value is a core element of the Value Framework. Specifically, the concept that RDI can, and should plan, for uptake and impact.
- The Framework should provide for tracking, analysing, monitoring, and evaluating stakeholder value across the full value chain of RDI. It should also deliver insights that enable the research institution to learn and improve. In other words, it should be dynamic and flexible.
- The value that certain stakeholder groups attach to water RDI might change over time. This will have to be captured in regular stakeholder research and the Framework adjusted accordingly.

Developing the Value Framework entailed the following steps:

1. Developing subcategories for the seven core values and identifying their associated indicators and high-level metrics
2. Integrating stakeholder value across the full project life cycle. It is proposed that the templates of the WRC's current planning, management, and evaluation (PME) tools, starting from the project proposal to the final Research Manager's report, be aligned with the core stakeholder values and their indicators.
3. Adding a Reflection Phase, which provides for stakeholder value to realise three to five years after the Completion Phase.
4. Adding two new PME tools: an Uptake & Impact Plan and a Monitoring & Evaluation (M&E) Tool. The proposed Uptake & Impact Plan plans for RDI uptake and impact and tracks progress and performance against a set of SMART indicators. The proposed M&E Tool monitors and evaluates the core stakeholder values and the associated indicators across the full project life cycle.

   The two proposed new PME tools extend from Inception until Reflection as the figure below illustrates.



The draft Framework was presented to 16 stakeholders of a sample of a further six WRC projects to obtain their input. The draft M&E Tool was tested with the Project Leaders of these six projects and subsequently refined.

It is proposed that all the PME tools use the same template format, which eventually could be web-based and integrated into the proposed M&E Tool.

The metrics of the proposed M&E Tool will provide the research institution with a rich diversity of insights that could be used for multiple management and reporting purposes. These include feeding data into the KPIs of the research institution and global innovation indices.

Applying the RDI Value Framework will furthermore empower the research institution to integrate stakeholder value into its operational processes. Drawing on the statistics and insights that the M&E Tool can offer, coupled with impact stories, the Framework will empower the research institution to report, and demonstrate, to stakeholders the value that its projects have realised.

Acknowledgements

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A special word of thanks to the Reference Group members, Dr Ashiel Jumman (South African Sugarcane Research Institution) and Mr Roelof Goosen (independent consultant), and the members of the Global Water Research Coalition for their valuable input.

We would also like to thank all the stakeholders of the WRC who were consulted for your time and your valuable contributions to shape this research. These include:

Internal stakeholders:
Mr Dhesigen Naidoo (CEO, WRC)
Dr Valerie Naidoo (WRC)
Dr Mandla Msibi (WRC)

Research partners:
Representatives from DWS, Department of Science and Innovation, SALGA, CSIR, Umgeni Water, Universities SA

Project stakeholders (Research managers, Project leaders, Reference Group members, students, and beneficiaries) of the following WRC projects:

1. WATCOST: manual for a costing model for drinking water supply systems
2. MiniSASS Data Management: development of an online map-based data portal (three projects)
3. Development of a framework for franchising in the water services sector in South Africa (more than one project)
4. Electric power supply measurement as an alternative to measure flow rates of hydraulic pumps
5. A feasibility and implementation model of small-scale hydropower development for rural electrification in South Africa
6. Demonstration and scaled-up implementation of pour-flush sanitation in South Africa
7. Data Magic: Using R and R marked down for water quality data science
8. Buffer Zone guidelines for wetlands, rivers, and estuaries (Part 1 and 2)
9. Design of Acid Mine Drainage Remediation Plant
10. Responsive Pipe networks
11. Water Use of Agroforestry systems for food and forage production
12. Case Study to Document Bio-Char Technology for Faecal Sludge Treatment and Beneficiation in East London.

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Table of Contents

List of Tables

List of Figures

List of Acronyms

PP	Annual Performance Plan
BDI	Business Development & Innovation
CBA	Cost Benefit Analysis
CESA	Consulting Engineers South Africa
CSIR	Council for Scientific and Industrial Research
DM	District Municipality
EIB	European Investment Bank
EU	European Union
GWRC	Global Water Research Coalition
I&I	Innovation and Impact
IP	Intellectual Property
IRS	Innovation Radar Survey
KPI	Key Performance Indicator
KSA	Key Strategic Area
LM	Local Municipality
M&E	Monitoring and Evaluation
MoU	Memorandum of Understanding
N/A	Not applicable
NGO	Non-Government Organisation
OECD	Organisation for Economic Co-operation and Development
PME	Planning, monitoring and evaluation
RAAIS	Rapid Appraisal of Agricultural Innovation Systems
R&D	Research and Development
RDI	Research, Development and Innovation
R&I	Research and Innovation
ROI	Return On Investment
SANBI	South African National Biodiversity Institute
SASTEP	The South African Sanitation Technology Enterprise Programme
SASS	South African Scoring System
StatsSA	Statistics South Africa
TAF	Technology Applicability Framework
TIA	Technology Innovation Agency
TIP	Technology Introduction Process
TOR	Terms of Reference
TRL	Technology Readiness Level
U&IP	Uptake & Impact Plan
UWA	University of Western Australia
VIPs	Ventilated Improved Pits
WADER	Water Technologies Demonstration Programme
WISA	Water Institute of Southern Africa
WRC	Water Research Commission
WSA	Water Services Authority
WTA	Willingness to Accept
WTP	Willingness to Pay
WUA	Water User Association

Chapter 1: Introduction

1.1 STRUCTURE OF THE REPORT

The project report comprises two volumes.

Volume 1 (this document) covers:

- A review of the theory, and
- A situational analysis that includes research on stakeholder value in past WRC projects and a first round of stakeholder research.

Volume 2 covers:

- The development of n RDI Value Framework and practical tools to facilitate, monitor, evaluate and report on stakeholder value derived from RDI
- A second round of stakeholder research, and
- Conclusions and recommendations.

1.2 BACKGROUND

This study forms part of a larger research project, called "Valuation of water Research and Innovation". The larger project is an initiative of the Global Water Research Coalition (GWRC), of which the Water Research Commission of South Africa is a member. GWRC members discuss, engage, and initiate projects that advance Research, Development and Innovation in water and sanitation which address common challenges or interests. The WRC's participation in this initiative required the WRC to initiate a case study focusing on South Africa (involving key stakeholders of the WRC).

The Terms of Reference (ToR) of this study described the research problem as follows:

> *In some cases, research and innovation are conducted to produce new knowledge and innovations that are poorly or not taken up by the water and sanitation sector or industries.*
>
> *One of the cause factors for this is the poor participation by the stakeholders (industries and public) in defining and expressing their needs with regard to RDI knowledge and innovation. This has resulted in the failure or lack of appreciation for the important roles that are played by water and sanitation research institutions. In some cases, opportunities and benefits from research are overlooked and never used to address challenges faced by communities in need or by the water sector.*

1.3 OBJECTIVES OF THE STUDY

According to the TOR, this study should:

1. Review and understand WRC's stakeholders' views and perception about value of WRC's research products and services.
2. Understand what WRC's stakeholders perceive as 'value' coming from research, development, and innovation.

3. Investigate if funders and the public (taxpayer) perceive to be getting value from water and sanitation research and innovation.
4. Identify how and where investments in water research and innovation provide value, as perceived and recognized by the primary users and funders of the research and innovation activities,
5. Work with other GWRC members to develop a range of metrics that can be used to guide WRC and its stakeholders' assessment of the value of water and innovation research activities within our respective contexts.

1.4 AIMS OF THIS STUDY

These general objectives crystallised into the aims of the South African case study as follows:

1. To investigate the concept of ''value'' with reference to research, development and innovation (RDI) in water and sanitation from the perspective of the relevant WRC stakeholders
2. To engage with stakeholders and develop an approach and methodology, including appropriate indicators (metrics), to plan, monitor and evaluate the value that the WRC's RDI projects deliver to stakeholders
3. To develop an instrument for RDI that could become part of the WRC's standard operating and reporting procedures and test it against the selected projects.

1.5 ''VALUATION'' AND THE SCOPE OF THE STUDY

According to the Oxford dictionary[1], the term "valuation" refers to the assessment and estimation of worth (usefulness and importance). Valuations are often based on an estimated monetary value.

This study aims to, not only assess the value (usefulness and importance) that the WRC's stakeholders ascribe to RDI, but also to develop a framework and associated planning, monitoring and evaluation (PME) tools to unlock stakeholder value.

The term ''evaluation framework'' is therefore too narrow for this study. Plus, as will be discussed in the literature review, not all RDI frameworks are structured to assess value; some are structured to facilitate uptake and impact to unlock value.

For this reason, this study will use ''RDI frameworks'' as the broader term.

[1] https://www.oxfordlearnersdictionaries.com/definition/english/valuation

Chapter 2: Further analysis of stakeholder value

2.1 ALIGNING STAKEHOLDER VALUE AND LITERATURE

In Volume 1, the research team reviewed the literature on RDI frameworks at research project level, the level of the research institution and national and global level. Frameworks evaluating RDI and facilitating RDI were reviewed.

Volume 1 also analysed the first round of stakeholder research to identify the value that different types of stakeholders ascribe to water and sanitation RDI and the associated indicators of such value.

The next task was to align stakeholder value with the literature. This comprised the following activities:

1. Identifying, per stakeholder group, the value that the WRC's RDI has for them, and the associated evidence-based indicators.
2. Aligning stakeholder value and indicators with the literature. This meant what we showed for each stakeholder value, the RDI framework(s) that talked to the same values and aligned the indicators that stakeholders mentioned with the corresponding indicators in the literature.
3. Grouping values and indicators according to the three levels at which the mentioned value manifests:
    a. At national and global level
    b. At the level of the research institution
    c. At the level of the RDI project.

The diagram below illustrates the task.

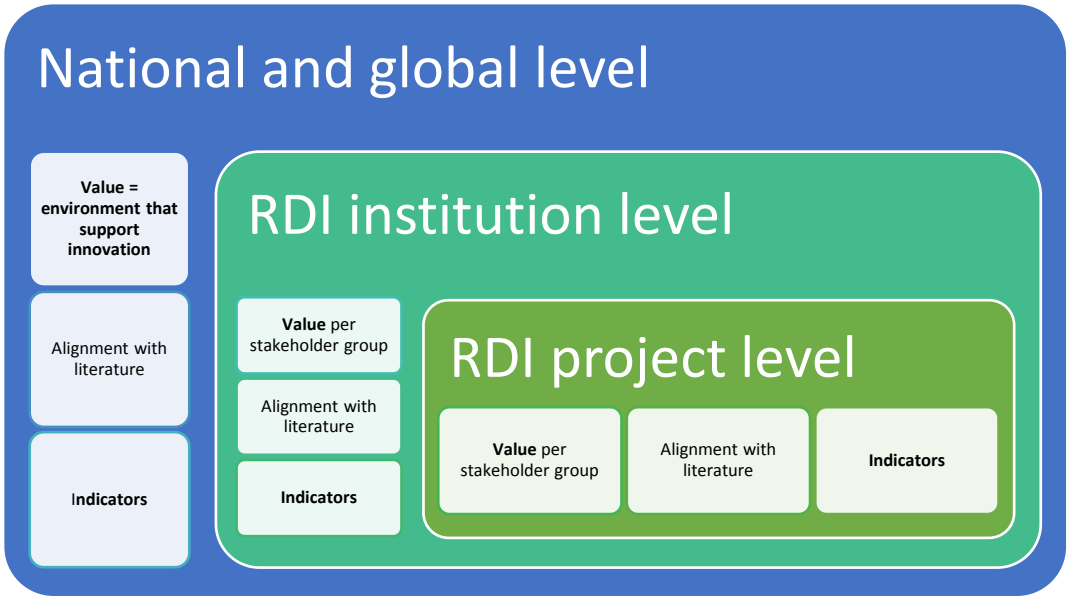


Figure 2.1: Aligning stakeholder value with the literature at three levels

We will now go into the detail of each level.

2.1.1 Indicators of a supportive national and global environment

This level is imperative as it provides the environment that advances innovation and provides inroads into decisions, policies, strategies and issues of global and national importance. The literature emphasises that, for innovation to flourish, national and global conditions must advance innovation.

For example, the Global Innovation Scoreboard (2021) lists the political, regulatory and business environment as critical for the advancement of innovation. It also identifies human and research capital, infrastructure, market and business sophistication as input pillars for innovation.

The European Innovation Scoreboard (2021) lists human resources, attractive research systems, digitalisation (broadband penetration; digital skills) and funding as indicative of an environment that is conducive to innovation. For example, qualifications at doctorate level in science, technology, engineering and mathematics and international publications are regarded as indicators of an environment that supports and attracts innovation.

In the first round of stakeholder engagements, two stakeholders mentioned that in the South African context it was important to remove regulatory barriers that prevent or slow down innovation. According to these stakeholders, DWS, the Water Boards, SALGA and National Treasury are currently in discussions to address these regulatory barriers.

Input and output indicators of innovation at national and global level are not further analysed in this study.

2.1.2 Value and indicators at the level of the RDI institution

The RDI institution governs and implement RDI projects. These institutions are often the ecosystem within which research problems are identified and solutions conceptualised which ultimately translate into the conceptualisation of RDI projects.

The table below summarises core stakeholder values and the associated indicators that can be measured at the level of the RDI institution. (See also Table 3.2)

1. The indicators are a mix of input and output indicators.
2. The input indicators are indicative of the research institution's capacity to deliver value to research partners. For example:
    a. Quality Management processes
    b. Quality of Research Managers
    c. Resource allocation reflected in organisational structure and funding model
    d. Ability to respond to stakeholder needs, for example, with shorter projects
3. The output indicators are aggregations of project level indicators.
4. **The stakeholder value and associated input and output indicators at the level of RDI institutions are not further analysed in this study**. It is recommended though that these indicators inform the RDI institution's KPIs and determine the criteria for any review of the RDI institution.

Table 2.1: Stakeholder values and associated indicators at level of RDI institution

Stakeholder value	Literature	Indicator(s)
Stakeholder group: Research partners (including Project Leaders)		
Collaboration (Perceived as being customer-centred; needs-driven; relevant)	EIB i2i model European commission – institutions Payback framework	- Bilateral discussions to understand needs (relevance) - Formal agreements - Mechanisms to engage with key stakeholders at individual level
Solutions	Payback framework EIB i2i model Cost benefit analysis framework JASPERS framework Cost-Benefit Analysis framework	Aggregate of project benefits: - Informing policy and product development - Water sector benefits (e.g. increased no of people with yard taps, cost savings, customer-service improvements) - Socioeconomic benefits (e.g. jobs created) - Cultural benefits Non-use benefits - Discovery as public good - Future use - Willingness to pay
Facilitate uptake	RAAIS UWA framework TAF & TIP	- Increased number of users and actual adoption levels - Organisational structure and project-related process to plan for uptake and impact
Water research is coordinated		- Institutional mechanisms to coordinate water research - Database of who is working on what and where and what is the status of their projects
Capacity building	All frameworks	- Aggregate of no. of qualifications achieved at project level - Aggregate of project-specific capacity building activities - Aggregate of career advancement (internal) - Knowledge creation (see quality indicators)
Quality	European Commission – institutions Global Innovation Index EIB i2i model JASPERS framework SIAMPI framework Oslo and Frascati Manuals	- Aggregated bibliometrics; altmetrics, contextual response analysis - Aggregated products (non-tech) - Aggregated proprietary registrations (patents, trademarks, designs, licences, proof of concept) - Aggregated commercialised products - For tech projects/innovations: Economic rate of return - Involvement of top researchers

Stakeholder value	Literature	Indicator(s)
		- Quality Management process (aligned with ISO 9001?)/RDI strategy, diffusion of technology) - Evidence of international standing (invitations, awards, international collaboration and funding) - RM's qualifications, performance, international standing
Stakeholder group: Public (as represented in the Portfolio Committee[2])		
Access to water and sanitation for all Capacity building Transformation and redress		- SDG6 targets met - Aggregate of qualifications achieved at project level - Aggregate of capacity building activities at project level - Aggregate of HDI numbers at project level

2.1.3 Value and indicators at RDI project level

RDI projects are at the centre of RDI development. It is at project level that technical or non-technical RDI outputs are developed, which can be aggregated to demonstrate value at institutional, national or global level. The project level is also instrumental in its value offering to develop solutions for the water sector, build capacity, establish partnerships, and create networking and learning opportunities.

The table below depicts the value that stakeholders derive from RDI projects, the alignment with the literature, and the associated input and output indicators. The last row is shaded in light blue to indicate that the value that end-users and beneficiaries derive from RDI outputs in terms of uptake and impact is project-specific and will be dealt with separately in the Uptake & Impact Plan (U&IP).

[22] The research team was unable to reach Portfolio Committee members. These stakeholder values and indicators are therefore assumed. More research is needed to get the actual value and indicators.

Table 2.2: Core stakeholder values and associated indicators at RDI project level

Stakeholder value	Literature	Indicator(s)
Stakeholder group: Research partners (often represented in Reference Group)		
Collaboration	EIB i2i model European commission – institutions Payback framework	- Involvement in project team or Reference Group
Quality	European Commission – institutions Global Innovation Index EIB i2i model JASPERS framework	- Reputation of Project Leader and research team - Project-specific bibliometrics, altmetrics, citations, awards, products (non-tech), patents, designs, licences, trademarks, etc. - Meet research institutions QM requirements - For tech projects/innovations: Economic rate of return
Project-specific solutions	Payback framework EIB i2i model Cost benefit analysis framework JASPERS framework CBA framework	Aligned with needs - Informing policy and product development - Water sector benefits - Socioeconomic benefits (jobs created, social impact) - Cultural benefits Non-use benefits
Stakeholder group: Research partners (in capacity as Reference Group members)		
Networking, learning	Innovation systems theory	- Spinoffs = related new projects and work
Stakeholder group: Research team		
Part of a solution	Payback framework benefits EIB i2i model	- Informing policy and product development - Water sector benefits - Broader socioeconomic benefits
Reputation, career advancement	All frameworks	- Project-specific bibliometrics, altmetrics, citations, awards, patents, etc.
Networking, learning	Innovation systems theory SIAMPI framework	- Spinoffs = related new projects and work - Knowledge creation (see quality indicators)
Stakeholder group: Students		
Capacity building	All frameworks	- Qualifications, bibliometrics, career advancement
Stakeholder group: End users and beneficiaries Individuals; communities; communities of practice, e.g. irrigation farmers; citrus growers; municipalities; research partners		
Project-specific: Value is different for different end-users and beneficiaries and different types of projects.	Planning for uptake and impact – SIAMPI framework, UWA framework, TAF/TIP, innovation systems approach	- Project-specific - To be developed in Uptake and Impact Plan of each project

Stakeholder value and the associated input and output indicators at project level will be further analysed in the next section.

2.2 EXTRACTING CORE VALUES

2.2.1 Seven core values

Although not all stakeholder groups ascribed equally to the same value, **seven core values** could be extracted from the first round of stakeholder engagements. These core values were checked and confirmed against the findings of previous stakeholder research that the WRC has done.

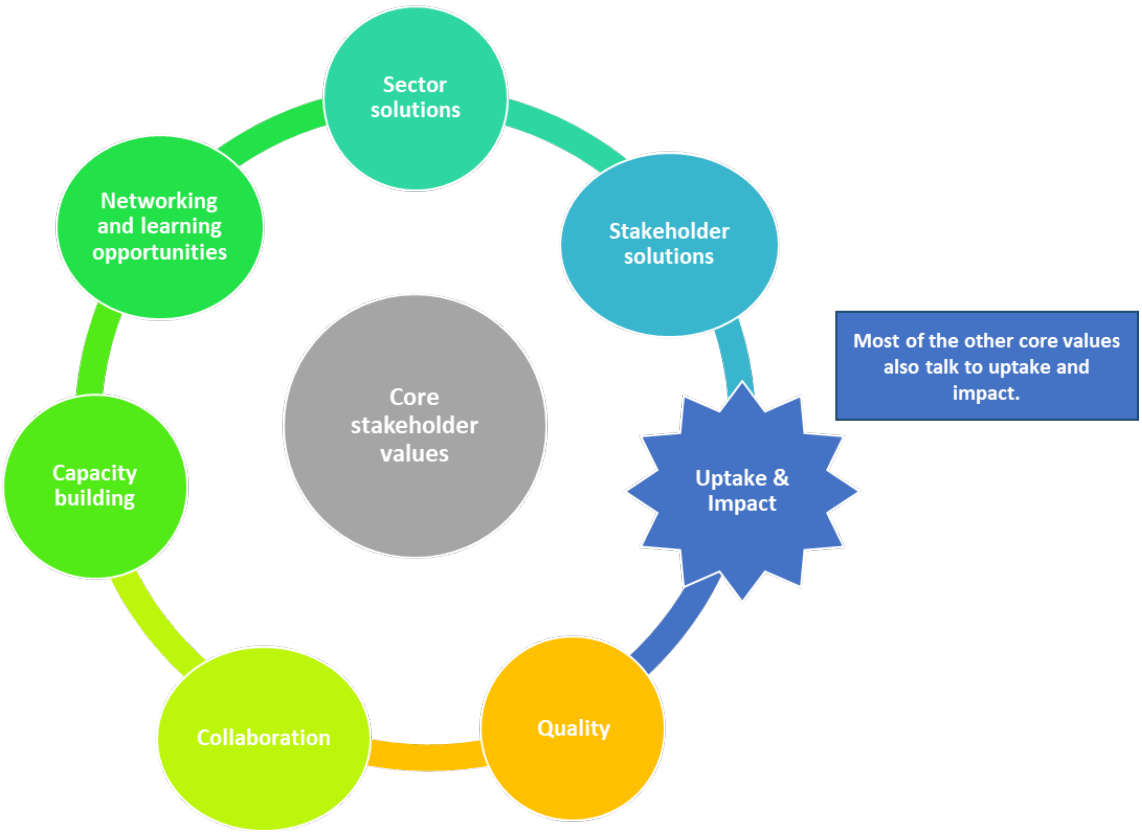


Figure 2.2: The seven core stakeholder values

2.2.2 Overlaps and distinctions

Collaboration, capacity building and networking and learning

There are overlaps between these three core values. For example, networking opportunities can lead to collaboration, and learning builds capacity. However, Reference Group members specifically mentioned networking and learning opportunities as their main motivation for participation. Their involvement in WRC Reference Groups is an opportunity to get exposed to research and innovation and also to network with colleagues from the sector. These networking opportunities have often led in the past to spin-off projects for the individuals and their organisations. They miss the face-to-face contact and the networking opportunity that they offered.

The distinction between Sector Solutions and Stakeholder solutions

The distinction was made by stakeholders although the distinction between the two is fuzzy. Sector solutions address general sector challenges. For example, the pour-flush toilet presents a low-flush solution to the sector. Stakeholder solutions refer to more specific challenges. For example, WATCOST allows municipal officials and their consultants to compare the cost of different water supply options.

Uptake & Impact

Although uptake & impact is often handled in the literature and by research institutions as a standalone category, **most of the other core values also talk to uptake and impact.** For example, capacity building activities often involve end-users and/or beneficiaries with the aim of capacitating them to use the RDI knowledge products with a resulting knowledge impact.

2.3 SUMMARY

The first round of stakeholder research found that the value that stakeholders ascribe to RDI is multifaceted and looks different for different groups of stakeholders. The research found overlaps in both value and indicators, but this overlap does not run across all representatives of a stakeholder group, nor does it run across all stakeholder groups. To give two examples:

- For research partners and Project Leaders, value and indicators overlap: RDI outputs that are used, offer solutions or that have an impact on people's lives are held in high esteem.
- For the beneficiaries of the six projects, the value of uptake and impact and the associated indicators were project-specific and unique.

The next task was to build an RDI framework based on stakeholder value. The insights from the stakeholder research indicated that:

1. The framework will have to consider, and be a composite of, these different stakeholder perspectives on the value of water and sanitation RDI.
2. **The value, or benefits, that end-users and beneficiaries derive from water and sanitation RDI, and the associated indicators, are project-specific and will have to be designed or developed for each project.**

Chapter 3: discusses the approach and method that was followed to develop such a framework.

Chapter 3: An RDI Value Framework

3.1 INTRODUCTION

The objective of this Framework is to measure and confirm the stakeholder value of an RDI project. Stakeholder value is contextualised as value to a range of stakeholders, including the end-users of the project outputs and the beneficiaries. Project value aggregates to the value that a water research institution like the WRC delivers to the water sector, and ultimately contributes to the national and global RDI indices.

Since this Framework must capacitate Project Leaders and Research Managers to unlock the full value of RDI projects for stakeholders, the research team calls it an RDI Value Framework. Ultimately, the Framework must help the water research institution to deliver demonstratable value to its stakeholders.

The draft Framework was presented to the GWRC during an online workshop on 20 January 2022.

3.2 GUIDING PRINCIPLES

The guiding principles in developing the Value Framework were the following:

- Stakeholder value, as defined and described in in the literature review, is the main pillar of the Framework, and it was also the starting point from where the Framework was developed
- The concept that RDI can be planned to realise stakeholder value is a core element of the Value Framework. Specifically, the concept that RDI can, and should plan, for uptake and impact.
- As far as possible, the Framework aims to consider the full value chain of RDI.
- The Framework provides for value improvement during, and beyond, the RDI project life cycle. In other words, it is dynamic and flexible. It also acknowledges that stakeholder value can change over time.

The development of the Value Framework comprised the steps below.

3.3 SUBCATEGORIES, INDICATORS AND HIGH-LEVEL METRICS

As a first step, the research team developed subcategories for each core value and set out the associated indicators and the high-level metrics in more detail, focussing on the project level.

Table 3.1: Core values, subcategories, value indicators and high-level metrics

VALUE CATEGORY **Value / Benefit**	**Description of value indicator**	**High-level metrics**
Sector solutions		
Improved sector performance	The project outputs contribute to improved sector performance in one or more of the areas below.	Qualitative Likert scale
	The project outputs facilitate improved **policies and decision making**	

VALUE CATEGORY Value / Benefit	Description of value indicator	High-level metrics
	The project outputs contribute to improved **water resources and/or environment**	
	The project outputs contribute to improved **water services (water supply and sanitation)** Examples: reduction in costs; improved processes; improved equity;	
	The project outputs contribute to improved **water use in agriculture, incl. water re-use**	
	The project outputs contribute to improved **water use in industry & mining, incl. water re-use**	
	The project outputs contribute to improved **energy management**	
Cross-cutting socioeconomic benefits	For example, increased income, jobs, start-ups, access to health services, markets, transport, business, education	Qualitative – Likert scale Quantitative
Stakeholder solutions		
Stakeholder solutions	Project delivers challenge-specific value to stakeholders	Qualitative Likert scale
Uptake & Impact		
Planning for Uptake and Impact	The project achieves its project-specific uptake & impact objectives. [See-project-specific indicators in Uptake & Impact Plan]	Project-specific
Knowledge exchange	The project includes knowledge exchange activities	Qualitative Likert scale Quantitative numbers
Learnings for future research	The project process includes the opportunity to reflect on lessons learnt and opportunities for future research.	Qualitative
(If relevant) Knowledge application and/or commercialisation	The knowledge or products that the project has produced will be applied or commercialised.	Qualitative Likert scale Description
(If relevant) Technology Readiness Level	The TRL level of the technology produced in this project	Actual TRL (1-9)
Quality		
People	Project leader has excellent track record; research rating, and recognised experience	Qualitative Likert scale
	Project team members has excellent track record, research rating, and recognised experience	Qualitative Likert scale
Processes and deliverables	Scientific/Technical soundness and credibility (aims, methodology, deliverables)	Qualitative Likert scale

VALUE CATEGORY Value / Benefit	Description of value indicator	High-level metrics
	Project follows innovative approach and/or delivers innovative products	Qualitative Likert scale
	Value for money (budget & timeframe appropriate for aims, methodology and deliverables; outcomes and expected impact)	Qualitative Likert scale
Knowledge outputs	Research outputs are held in high regard because of quality and innovativeness Examples of outputs: publications, conference papers, briefs, commercial products.	Quantitative Numbers
Recognition	The project outputs and/or team receive recognition	Quantitative Numbers
Collaboration		
Stakeholder engagement	Project led to institutionalised relationship/MoU	Quantitative Numbers
	Users and/or beneficiaries are part of the project team or Ref Group	Qualitative Likert scale
	Users and/or beneficiaries get the opportunity to comment on deliverables or products	Included in above
Capacity building		
Capacity building and career advancement	The project contributes to post-graduate qualifications	Qualitative Likert scale Quantitative numbers
	The project advances the career(s) of the project team	Qualitative
	The project offers training for users and/or beneficiaries	Qualitative Likert scale Quantitative numbers
Networking and learning		
Networking and learning	Project leads to spin-off projects or other initiatives for the Project Leader and/or team	Qualitative
	Project leads to spin-off projects or other initiatives for the Reference Group	
	Ref Group members report positively on the networking opportunities that the project offered	Qualitative Likert scale
	Ref Group report positively on the learning opportunities that the project offered	Qualitative Likert scale

3.4 INTEGRATING STAKEHOLDER VALUE ACROSS THE PROJECT LIFE CYCLE

3.4.1 Planning, Monitoring and Evaluation across the project life cycle

Research organisations typically use management templates to plan, monitor and evaluate projects. We refer to them as PME tools. Examples include templates such as the project proposal, internal and external review, the Research Manager' report, the Reference Group report and the New Knowledge report.

The figure below illustrates how these tools are used across the project management life cycle:

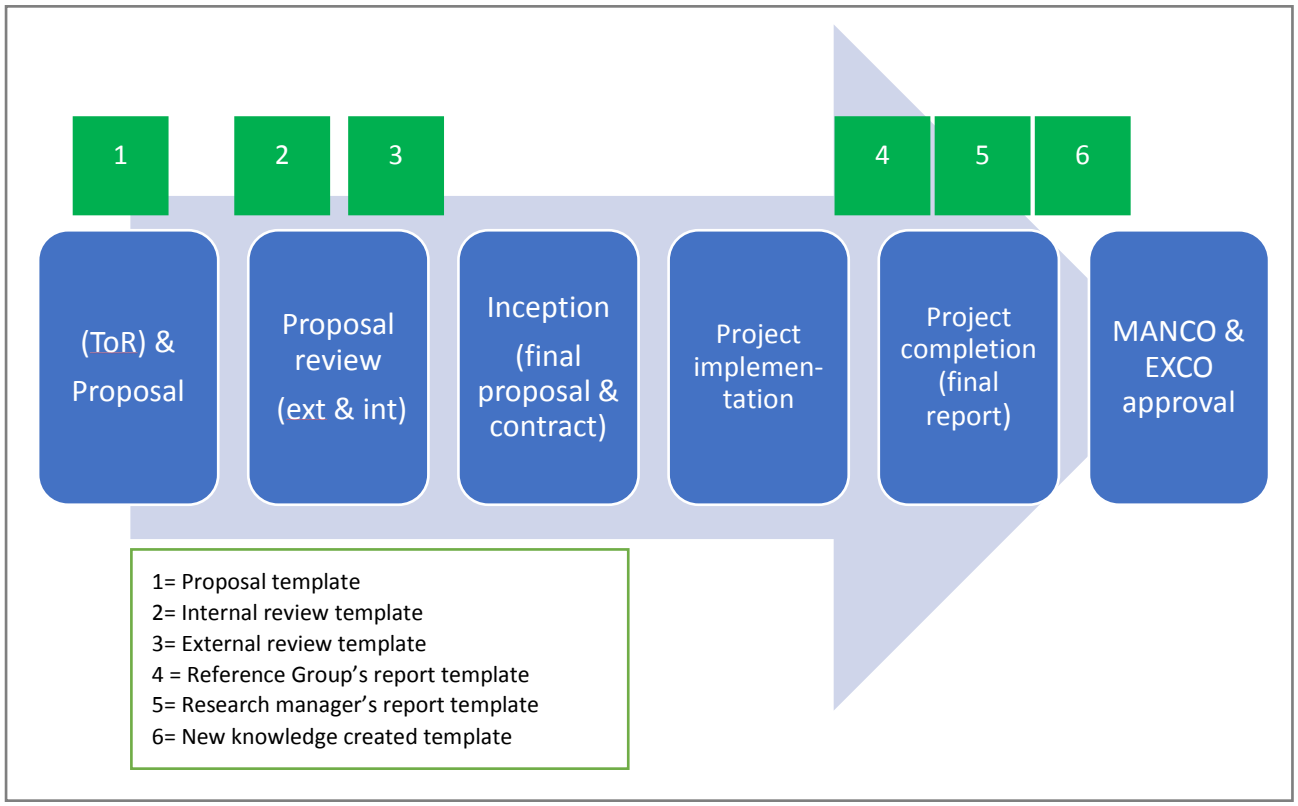


Figure 3.1: PME tools mapped onto the project life cycle

To optimise stakeholder value, we propose two actions:

1. Adapting the research institution's existing PME tools to align them with the identified core stakeholder values and their associated indicators. This will empower the research institution to report on project performance in terms of stakeholder value.
2. Adding two new PME tools:
    a. A project-specific Uptake & Impact Plan
    b. A consolidated monitoring and evaluation (M&E) tool to track stakeholder value across the full project life cycle. The scores of the adapted PME tools will feed into the M&E tool.

Adapting existing PME tools is discussed in the next section. The proposed two new PME tools are discussed in 3.5.

3.4.2 Adapting existing PME tools

The table below illustrates the current alignment of the core values and the WRC's PME tools. The proposal structure was used as the basis.

Table 3.2: Stakeholder value reflected in WRC's current PME tools

	Stakeholder value reflected in WRC's current PME tools				
Core stakeholder value	**Proposal**	**Consolidated review**	**New knowledge report**	**Final RM report**	**Ref group report**
Solutions	Motivation Outcomes and expected impacts	Relevance	Needs-based products Gap filled by new knowledge		
Quality	Aims Methodology Deliverables	Scientific/ technical soundness and credibility		Meeting of objectives Quality of deliverables	Scientific content
Uptake					Readability of report
Solutions	Innovation	Innovation	New knowledge	Creation of new knowledge	Innovative findings
Capacity building	Capacity building			Capacity building Incl no of students	
Uptake	Outcomes	Knowledge application/ commercia-lisation		Knowledge application Commercia-lisation & innovation	Practical application
Solutions	Products		Innovative products		
Uptake	Knowledge dissemination and research uptake	Knowledge dissemination		Knowledge dissemination Incl. no of activities	
Uptake			Users & beneficiaries identified		
				Resources leveraged	
Quality	Budget and time frame Outcomes and expected impact	Value for money		Value for money	
Impact	Impact areas of knowledge tree	Impact areas of knowledge tree			Overall impact score
Impact	Impact areas of light houses	Impact areas of lighthouses			
Quality	CVs	Research team track record		Project leader track record	

To align the PME tools with the core stakeholder values, **a re-structuring of the PME tools** is proposed, as set out in the table below. The re-structuring entailed the following:

- The proposal structure was slightly re-organised to group together the aspects that relate to solutions as a stakeholder value.
- The new knowledge report was expanded and called a Project Leader's report. Uptake & Impact Plan is a new term that will be explained in 3.5.1.
- Some of the sections have has been crossed out and replaced by text in red. The red text is either a proposed new section or a proposed re-phrasing that aligns better with the relevant stakeholder value and the other PME tools.

  For example: In the project proposal, the Project Leader is expected to motivate the relevance of the study, including the needs that it will address and the gap that the new knowledge and products will fill. Instead of making the Project Leader the referee (as in the New Knowledge report), the re-structuring allocates this task to the reviewers, and the Research Manager and Reference Group at project completion.

Table 3.3: Proposed re-structuring of WRC's PME tools

Proposed re-structuring of WRC's PME tools					
Core stakeholder value	Proposal	Consolidated review	Project leader ~~New knowledge~~ report	Final RM report	Ref group report
Solutions	Motivation Outcomes and expected impacts	~~Relevance:~~ Needs based	~~Needs-based products Gap filled by new knowledge~~	Needs addressed	Needs addressed
Solutions	Innovation	Innovation potential Gap filled by new knowledge or products	Innovation confirmed ~~New knowledge~~	Innovation confirmed Gap filled by new knowledge or products confirmed ~~Creation of new knowledge~~	Innovation confirmed Gap filled by new knowledge or products confirmed ~~Innovative findings~~
Solutions	Products		~~Innovative~~ Products confirmed		
Uptake	Users & beneficiaries identified		Users & beneficiaries confirmed		
Uptake	~~Outcomes?~~ Knowledge application/ commercia-lisation TRL if relevant	Knowledge application/ commercia-lisation	Knowledge application confirmed TRL if relevant	Knowledge application/ commercialisation Commercia-lisation ~~&~~ ~~innovation~~ TRL if relevant	~~Practical~~ Knowledge application / commercialisation

Proposed re-structuring of WRC's PME tools					
Core stakeholder value	Proposal	Consolidated review	Project leader ~~New knowledge~~ report	Final RM report	Ref group report
Impact	Impact areas of knowledge tree	Impact areas of knowledge tree	Uptake & Impact report Impact stories	Impact	Impact ~~Overall impact score~~
Impact	Impact areas of light houses	Impact areas of lighthouses			
Quality	Aims Methodology Deliverables	Scientific/ technical soundness and credibility		Meeting of objectives Quality of deliverables	Meeting of objectives Quality of deliverables ~~Scientific content~~
Quality	Budget and time frame Outcomes and expected impact	Potential value for money		Value for money	Value for money
Collaboration	Stakeholder engagement	Stakeholder engagement	Stakeholder engagement confirmed	Stakeholder engagement	Stakeholder engagement
Capacity building	Capacity building		Capacity building confirmed	Capacity building Incl no of students	Capacity building
Uptake	Knowledge exchange and research uptake	Knowledge exchange	Knowledge exchange confirmed	Knowledge exchange Incl no of activities	Knowledge exchange
Uptake				Readability of report	Readability of report
Quality	CVs	Research team track record		Project leader and research team performance ~~track record~~	Project leader and research team performance
Networking & learning			Spin-off projects or other initiatives that resulted from project		Spin-off projects or other initiatives that resulted from project
Networking & learning			Career advancement that resulted from project		Networking & learning opportunities that project offered

It is proposed that all the PME tools use the same template format, which eventually could be web-based and integrated into the proposed monitoring and evaluation tool. See 5.7 for an example in a Google form.

3.5 TWO NEW PME TOOLS

WRC stakeholder research, in previous research and in this study, pointed out that the uptake and impact of most research projects realise after project completion. For example, RDI projects often have delayed benefits such as uptake of technology, impact, awards, citations, or publications.

Currently, the planning, monitoring and evaluation of RDI projects stop at project Completion Phase. We propose therefore that a further phase be added to the project life cycle, which we call the 'Reflection Phase'. The Reflection Phase extends three to five years beyond the Completion Phase.

The two proposed new PME tools, the Uptake & Impact Plan and the Monitoring & Evaluation Tool extend from Inception until Reflection as the figure below illustrates

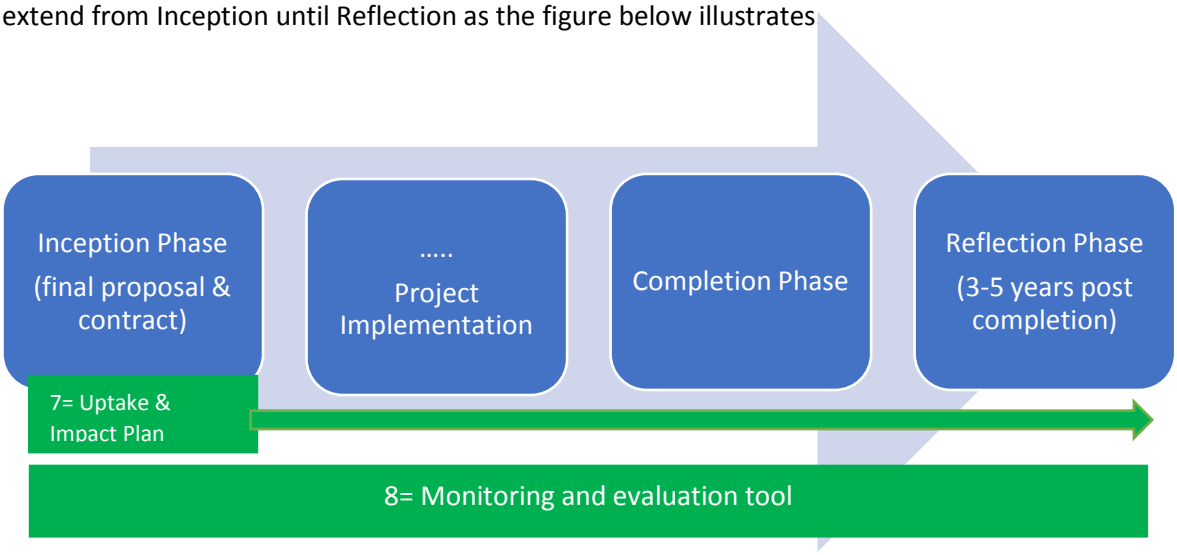


Figure 3.2: Proposed new PME tools mapped on the project life cycle

The recommended PME format for the Reflection Phase is a once-off debrief session between the Project Leader, the Research Manager, the BMI division, and available Reference Group members. At the debrief, the participants will update the reports submitted at Completion (Research Manager's report and Project Leader's report, as well as the Monitoring & Evaluation Tool discussed below.

An alternative format would be a once-off debrief workshop for a group of projects, which include the participants mentioned in the previous paragraph.

3.5.1 Uptake & Impact Plan

The proposed Uptake & Impact Plan plans for RDI uptake and impact and tracks progress and performance against a set of SMART indicators. It will be a self-assessment tool for the project team, but it will also assist the research institution to collect and aggregate data on the uptake and impact of its projects.

It is envisaged that the Uptake & Impact Plan (U&IP) be developed in the period between approval and implementation. It is proposed that the U&IP becomes part of the project contract, with a clause that states that the lead organisation will not be held responsible for outcomes that it could not control.

To realise maximum stakeholder value, it is proposed that the Project Leader develop the Uptake & Impact plan in collaboration with the Business Development & Innovation (BDI) division of the research institution (WRC), the Research Manager and representatives of the end-users and beneficiaries.

The Business Development and Innovation division would play a key supporting role in the U&IP by providing:

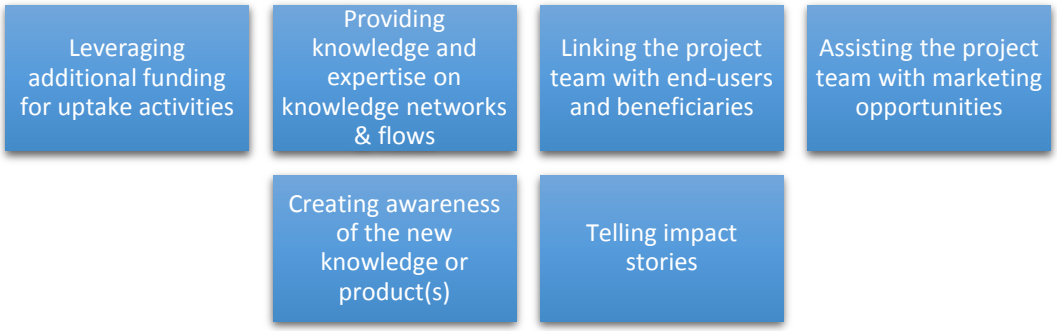


Figure 3.3: Support opportunities for the WRC's Business Development & Innovation department

Developing a full-scale U&IP for each research project might not be feasible. However, there would be the opportunity to group projects with the same end-users or beneficiaries together. This, in turn, would address the need that stakeholders expressed for a mechanism to coordinate research and to inform research partners of new knowledge and products in the pipeline.

The U&IP should include at least the following:

- Confirm the end-user and beneficiaries and investigate knowledge networks and knowledge flows.
- Ensure end-users and beneficiaries know about the RDI – create awareness.
- Ensure that end-users and beneficiaries access the new knowledge via knowledge sharing activities and their active involvement in the project, for example in the Reference Group or as an advisory panel.
- Define SMART value indicators in collaboration with end-users and beneficiaries.
- Set up mechanisms to monitor and evaluate – mid-project life cycle, at project completion, and up to 3-5 years beyond the project life cycle.
- Set up mechanisms to market the value generated, for example through a video, trade magazines, social media, or professional networks.

For products that are planned to be commercialised, the Uptake & Impact Plan should include:

- The current and intended technology readiness level
- Innovation management – a business plan, actions to secure investment, and to facilitate technology transfer, and
- Evidence of market potential.

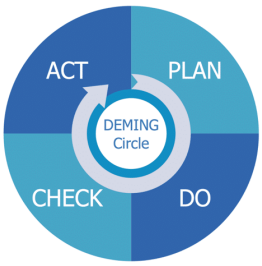
Recommendations:

1. Template: Develop a U&IP template. See example below.
2. Reporting:

a. It is recommended that the Project Leader report on the outcomes of the U&IP at project completion. The U&IP report could form part of the proposed Project Leader's completion report.
b. It is recommended that the Project Leader reports on progress on the implementation of the U&IP mid-way through the project. This could be in the form of a meeting with the Research Manager and a representative of BDI. The purpose would be to monitor the key indicators to ensure that they on track. Where necessary, corrective action can be identified and undertaken.

Below is an example of U&IP template. The template incorporates elements from the three facilitating RDI frameworks that are discussed in the literature review (Volume 1 of this report) (Schut et al., 2015; University of Western Australia, Research Impact Toolkit; WASHTech, n.d.)

Uptake & Impact Plan – template



The Plan follows the basic steps of the Deming circle[3]: Plan, Do, Check, Act. The template is structured to enable a Project Leader to purposefully plan and facilitate activities for maximum uptake and impact as per the values and indicators described in the RDI Framework.

Plan

Activities to understand who the potential users and beneficiaries are, and to determine focus			
Activity	**Relevant (Yes/No)**	**Detail**	**Budget required**
Define the potential impacts of the RDI/new product			
List end-users and potential beneficiaries			
Identify their knowledge networks			
Identify knowledge brokers/intermediaries, and plan to collaborate with them			
Research the advantage and need for this RDI/new product with users and potential beneficiaries, plus barriers to adoption.			

[3] https://deming.org/explore/pdsa/

Activities to influence uptake and impact			
Activity	**Relevant (Yes/No)**	**Details**	**Budget required**
Comms strategy			
• Key messages			
• Plan knowledge/technology exchange			
• Plan training (capacity building)			
• Plan how to market benefit of RDI			
Strategy to collaborate with end users, beneficiaries, intermediaries/knowledge brokers			
For commercial products:			
• Business plan			
• Actions to secure investment			
• Market research			

If relevant/appropriate: define SMART impact goals, indicators, time frame – put the necessary metrics in place. Examples of impact goals would be hydropower to a rural community; an improvement in a wastewater treatment process, increased water metering by commercial irrigators, or DWS implementation of a guideline.

SMART goals	Indicators	Timeframe

Additional funding secured	
Activity	**Amount**

Do and check

Implement/Roll out			
Activity	**Date(s)**	**Achieved/not achieved**	**Details**
At Inception Phase, research advantage and need for RDI/new product with users and potential beneficiaries, plus potential barriers to adoption.			
Collaboration			
Communication			
• Knowledge exchange			
• Training (capacity building)			
• Marketing the benefit of RDI/product			
For commercial products:			
• Take BP to action			
• Secure investment			
• Conduct market research			

SMART impact goals	Indicators	Timeframe	Achieved/Not achieved	Learnings

Act

Recommendations for:

- Non-project activities which are essential for ongoing uptake and impact
- Ongoing knowledge exchange and capacity building, or support and maintenance of technology/products after project close out, and
- Future projects.

3.5.2 Monitoring and Evaluation Tool

The proposed Tool monitors and evaluates the core stakeholder values and the associated indicators across the full project life cycle. It has the following functionalities:

1. For each RDI project, the Tool enables the RDI institution to track the indicators of the seven core stakeholder values across the standard project phases and 3-5 years beyond project completion, and
2. At the Inception Phase, the tool embeds the Uptake & Impact Plan (U&IP) which sets its own indicators against which progress, and performance can be measured.

The draft M&E Tool was tested with the Project Leaders of six WRC projects – see Chapter 4: Second round of stakeholder research. The details of the M&E Tool are discussed in Chapter 5: Monitoring and evaluation tool.

3.6 ENABLING POWER OF THE RDI FRAMEWORK

Applying the RDI Value Framework will empower the research institution to integrate stakeholder value into its operational processes. It will also empower the research institution to not only report to stakeholders on the value that its projects have realised, but also to feed information into national (and global) innovation indices. The figure below illustrates this dynamic.

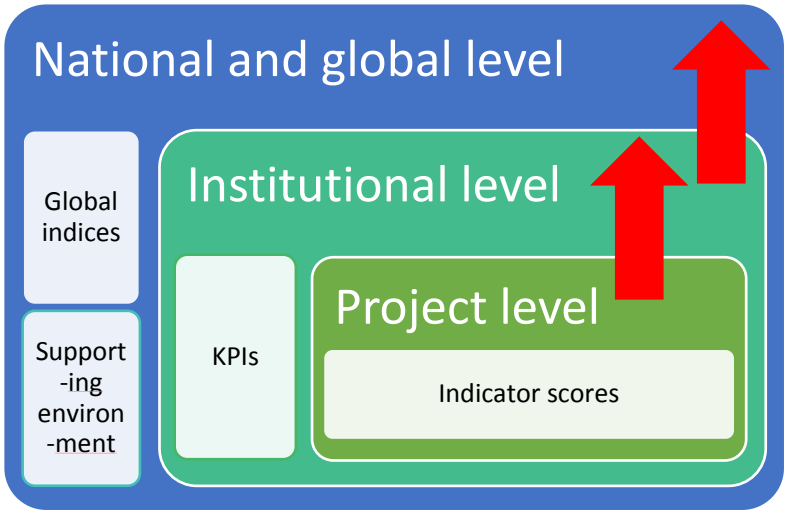


Figure 3.4: Information feed from project level to institutional to national and global level

At project level, core stakeholder values and associated indicators are reflected in all PME tools and performance is monitored and evaluated across the full project cycle and extended to the Reflection Phase.

At institutional level, the institution's KPIs (WRC's annual performance plan) comprise three sets of indicators:

- Performance indicators that are structured in terms of the seven core stakeholder values (data is aggregated from the project level),
- Performance indicators that demonstrate that the WRC is establishing a supportive environment, as mentioned by stakeholders and the literature.
- Indicators of management and financial performance, which were not considered in this project.

At national (and global) level, the WRC can supply the relevant innovation performance data (for example the number of technological innovations and their technological readiness levels, or bibliometrics) for national and global innovation indices. The WRC could also inform government of actions needed to establish a national environment that supports innovation, as mentioned by its stakeholders.

Chapter 4: Second round of stakeholder research

4.1 INTRODUCTION

The second round of stakeholder research aimed to:

1. Present the draft Value Framework to a sample of WRC project stakeholders and obtain their input on key questions, such as:
    a. Does the RDI Value Framework follow the logic of a typical RDI project across its life cycle?
    b. Does the Framework manage to extract the key indicators to measure the core values?
    c. Does the Framework provide a rational basis for the development of a tool to monitor and evaluate the stakeholder value that RDI projects generate?
2. Test the draft M&E tool with a sample of Project Leaders.

4.2 METHODOLOGY

The same selection criteria as for the first round of stakeholder engagements (see Table 3.2) were used to select the following projects:

1. Project No 2730/1/19: Data Magic: a water quality data analysis and visualization platform that has been developed based on R and its associated packages. This tool makes use of existing software for a relatively new application; that is for water quality data analysis. The innovation also includes a decision support tool in the form of a manual which can assist with the investigation and verification of future microbiological data.
2. K2757/121: Acid Mine Drainage (AMD) Remediation Plant: an AMD remediation system using a unique combination of waste products from the steel and sugar industries.
3. K827/20: A method of Agro forestry to maximize yield for livestock feed production.
4. K2726/1/19: Responsive Pipe Networks: the proposed technology provides a highly sensitive means of leak detection on water pipelines or conduits such as canals by making use of optic fibre as a means of passive leak detection.
5. K5/2463: Buffer Zone Guidelines for Rivers, Wetlands and Estuaries.
6. Not published yet: Case Study to Document Bio-Char Technology for Faecal Sludge Treatment and Beneficiation in East London.

The discussion guides used to conduct the stakeholder interviews are attached as Appendix A. The discussions with the project teams were conducted as an in-depth mini focus group (2-2,5 hours each). The six mini focus groups were made up of the six Project Leaders, two specialist researchers, four students, and four Reference Group members (16 interviewees in total). The discussions took place online and were recorded.

After the focus group discussion, each Project Leader was asked to complete the draft PME Tool in their own time. They had to fill in values in retrospect and give comments on the indicators.

4.3 FOCUS GROUP SUMMARIES

Below is a summary of the six mini focus group discussions. See Appendix B for the full summaries of each project.

4.3.1 General comments

The WRC is commended for doing this project, given the scarcity of funds and budget cuts to RDI. Some interviewees believed that a positive project evaluation will help them to be successful when applying for other projects or for additional budget.

All groups agreed in principle with monitoring and evaluation along the project value chain. However, they stressed that caution should be exercised in terms of planned numbers. For example, it is not realistic to plan for citations or an exact number of peer-reviewed publications.

All groups agreed that the Framework adds value by 1) raising awareness to plan for uptake and impact; 2) focussing the research team to plan deliberately for stakeholder value by using the indicators as guidance; 3) giving the opportunity to renegotiate budget, timelines, and project duration during Inception to strengthen uptake and impact through agreed appropriate mechanisms.

The groups felt that 60 indicators were too many. However, they understood after the PowerPoint presentation, that not all indicators would be relevant for all projects.

Three groups indicated that the WRC process already considers many of these indicators, and that the proposed Framework does not introduce major changes to the existing monitoring and evaluation instruments. The exceptions are the Uptake & Impact Plan and the addition of the proposed Reflection Phase. The introduction of a M&E Tool that generates a stakeholder value score for RDI projects is also new.

One group stressed that uptake and impact are complex and often driven by external factors, for example new regulations or a crisis. The success of RDI projects should therefore not be solely based on the extent to which the RDI outputs are used (taken up) or by the impact that they have. All participants emphasised that the WRC should play a more pertinent role and take responsibility for influencing government and policy and bringing key actors and partners together through the WRC's networks, reach and reputation. This would ultimately translate into uptake and impact of RDI knowledge and products in the sector(s).

The groups supported tracking project outputs and performance in all the proposed ways, as it will emphasise the accountability of all involved persons and parties in an RDI project.

One group suggested that the project performance scores be linked to a WRC Research Manager's performance review, as these scores would be a direct indication of the success of the person's involvement and guidance to maximise value, uptake, and impact. Project evaluations in terms of stakeholder value delivered would also urge the Research Manager or Business Development & Innovation Manager and/or the International Cooperation & Partnerships Manager to improve their footwork in the industry and to seek partners to transition from research to uptake in the industry.

The research team who did a project in KSA 4 (Agriculture) supported the idea of setting quantitative or qualitative project indicators, because the felt it would increase awareness of these indicators and influence the thinking of researchers.

The groups were more interested in the indicators of stakeholder value at project level that at institutional level or national/international level. It has the most relevance for them and they expressed confidence that the Framework offers value at this level. They did not comment on the value indicators at national/international level. They felt they would only be able to comment once the proposed data flows have become active.

One group stressed that the RDI Roadmap is good but that it needs a multi-billion investment strategy. The proposed Value Framework and M&E Tool could be communicated as a mechanism to monitor and evaluate the RDI Roadmap against value delivered.

In conclusion, the groups thanked the WRC for the opportunity to participate, as the discussions brought new perspectives on the cross-functional roles of managers, researchers, and students. The engagement was regarded as useful, with diverse but complementary views and experience of WRC projects shared.

4.3.2 Specific comments

4.3.2.1 Terms of Reference (ToR) and Project Proposal

The groups felt that Project Proposal template should refer to the list of indicators and ask the proposer to address these in the proposal. This will raise awareness and urge the proposer to consider stakeholder involvement and plan for uptake and impact.

ToRs should encourage proposers to look for co-funding partners.

4.3.2.2 Project Proposal Review

Two sets of opinions emanated from the discussions:

1. On the one hand, there were participants who were in favour of retaining the existing set of project review criteria, because reviewers are familiar with them, they are user-friendly, and they produce meaningful results for decision making.
2. The opposing view was that the criteria are vague, do not provide sufficient guidance and are subjective, arbitrary, and open to interpretation.

The recommendations related to the two opinions were:

- To keep the review criteria as is
- To retain Relevance and Scientific Soundness, and to incorporate the seven proposed Value Categories into a new structure
- To replace the existing review criteria with the proposed seven value categories in alignment with the Value Framework with the condition that the new review process remains simple and time-efficient (Reviewers are volunteers and will not appreciate complex review formats).

Several groups referred to Value for Money in the external reviews as an indicator that is hard to define or measure. Alternative suggestions were made, for example: *"What does the WRC want to see for spending this money/investment?"* and *"What does the Project Manager offer for the budget?"*

4.3.2.3 Impact & Uptake Planning

Three groups felt that project uptake and impact cannot be planned or predicted, as there are too many unforeseen barriers. Also, uptake is often driven of influenced by crises, the current political climate, topical issues or market trends, or a need in the sector or market. None of these can be predicted with certainty.

The other three groups felt that planning for uptake and impact planning is needed. One Project Leader said that if an inception phase and SMART indicators had been introduced (in their project) , it would have ''forced'' the project team to think about uptake and the potential of the project and put measures early on in place to ensure uptake if the research product warranted such investment. Industry partners must be identified and activated from the very start of a project to ensure that the research product can transition into uptake via an active partnership who sees the value and invests in the product.

The groups cautioned against unrealistic expectations of uptake and impact by Completion. Uptake and impact often realise years beyond Completion. Even the Reflective Phase might be too soon. The groups also emphasised that there must be expertise and capacity within the WRC that can support uptake and impact planning.

More intensive marketing of new knowledge and knowledge products was consistently and urgently raised by all groups. The following opinions were raised, and suggestions made:

1. The responsibility for marketing resides at three levels: the research organisation (WRC), the research team, and the stakeholder or partner. Marketing a research project's knowledge outputs and products should consider resources at all three these levels.
2. Researchers are thinkers and designers; their skills in marketing and communication are limited. These areas require a different expertise.
3. A research product should exit the WRC project cycle, and enter a marketing cycle with budget and capacity created in the WRC, in collaboration with a sector partner such as TIA, DWS, etc.

4.3.2.4 Completion & Reflection Phases

All groups observed that most projects realise their highest stakeholder value in the Reflection Phase, that is 3-5 years after project completion. The Reflection Phase is currently absent from the WRC RDI project cycle. A 5-year period is supported, or longer. Certain indicators can be achieved at project completion, but the high impact indicators take a longer timeline to realise, for example Masters dissertations and doctoral theses, peer-reviewed articles, patents, CPD training courses, books, co-funding and partnerships.

Five of the six groups felt that Project Leaders would be able to supply the required information on the quantitative indicators. Some of the information would be available at Completion, but most at Reflection.

The proposed mid-project review was not supported, or partially supported. All groups felt this is already incorporated in the final Reference Group meeting. Some felt that they would at most support a 'light touch' mid-project review, in light of the opportunity that it might offer to change the trajectory of a project when needed, thereby allowing ''flexibility''.

4.3.2.5 Suggestions for indicators

RDI projects differ in design and nature, and not all indicators will be relevant. The M&E Tool must allow the option to rule-out unrelated indicators and only measure those agreed and selected. The tool must allow for flexibility by considering "If a particular type of project, then...."

The tool should also be flexible enough to cater for unplanned circumstances, so that projects are not unnecessarily penalised by the algorithm.

The following suggestions were made regarding the knowledge output indicators:

1. Add indicators that speaks to Technology Development Reports, Concept Papers or Blueprints – instead of (or in addition to) a commercial output.
2. Add an indicator for activities that are repeated after project completion to accommodate the need to reinforce knowledge sharing and learning via workshops, conferences, further articles, interviews, or training towards uptake and impact.
3. Add an indicator for 'the opportunity to be commercialised', based on the question "is this research that can possibly result in commercialisation?"
4. Include published conference proceedings (raised by all the academics).
5. Include Win-SA lessons and case studies as they are practical and easy reads for a variety of audiences.
6. Eliminate predatory journals by specifying 'DoHET-accredited peer journals'.
7. Include trade magazine articles.
8. Include policy and other briefs.
9. Citations: the expectation is for Yes at inception / 0 at completion / high numbers at Reflection / very high numbers after 10-20 years.

Collaboration indicators should include:

1. Opportunities to leverage or link to other projects or programmes
2. Opportunities to leverage or link with partners or stakeholders (who has an interest in the new knowledge, or who could benefit, and who has funding available).
3. Securing co-funding for follow-up phase (from WRC or external).

Sector solution indicators:

1. Include benefits (value) to the end-user such as: 1) recovery of a wasted resource (faecal sludge), 2) skills of women, 3) alternative income stream. The value to the partner would be 1) income generation of low-tech, 2) fulfilling service delivery mandate.

The following suggestions regarding uptake and impact indicators were made:

1. Uptake indicators should be more tentative and instead of referring to actual uptake, they should refer to ''opportunity to create uptake''.
2. Include the contribution that the research product makes to policy or legislation.
3. Include active partners confirmed (define active partner as one with interest, one who directly benefits, and one who has resources).
4. Include positive Return on Investment or cost-benefit calculation (very few projects will select this indicator).

The following suggestions were made for Capacity Building indicators:

1. From a student's perspective, a suite of indicators was regarded as representing value:
    - Gained skills
    - Mastered interpretation of raw data
    - Mastered a deeper way of thinking and approaching a problem
    - Exposure to the world of RDI
    - Design and research experience under his/her promoter
    - Received payment / became financially independent
    - A positive lasting mentorship experience.
2. Include uptake of product into academic curriculum or post-graduate projects.

3. Give special mention to accredited or CPD earning training via partnerships with SETA or professional institutions (WISA, SAICE, ECSA, etc.).

4.3.2.6 Mechanisms proposed to improve Uptake & Impact

The focus group participants proposed the following mechanisms to improve uptake and impact:

All groups emphasised the importance of repetition and follow up activities after Completion Phase. The practice to exit a project often with only a limited number of workshops, training and articles does not support uptake and impact. It was proposed that a budget and continuance period be allowed after project completion to cater for more workshops, conference presentations, training sessions, etc. This, in turn, will ensure transition from a pure research output towards end user uptake and impact through replication and reaffirmation.

The WRC should intensify its efforts to transition concepts or products to the next level, which is uptake.

Uptake and impact should be monitored and reported over longer timelines. This can be achieved by setting systems, M&E tools, and dedicated resources. The trends and results will indicate implementation and uptake of WRC RDI products in the sector. Measurement functionality is already built into the WRC system and can be broadened to incorporate an M&E tool. The WRC has a large database (BMS) with a wide reach to people and organisations. Automatic triggers can be configured to collect information during Reflection Phase or to support repetitive events after project completion.

WRC research partners do not perceive it to be their role to monitor and evaluate uptake and impact. They recommended that it be ring-fenced in WRC, with budget, as a stand-alone activity. The example of TIA that hired a specialist company was quoted.

Several participants suggested digital platforms to share new knowledge with users, for example a platform or portal to share spatial data to users to enable use of products. Wader was cited as another example: Wader developed a national testbed for water solutions in 2018 which intended to give access to different types of RDI products to users, stakeholders, and partners. This concept must be explored as mechanism to broaden access to technology with the intent to improve uptake and impact.

Feedback reports to stakeholders hold high value since it will strengthen the position of WRC as a necessary and valuable player in the sector by generating impact, training more students, generating more knowledge, and creating and mobilising expertise. A suggested format for a stakeholders' report-was a 2-pager document with statistics from the metric to report on students, journals, potable water in taps, expenditure (R1m delivered: XYZ), etc. on page one, and on page 2, the actual story about a student (from where, what did she do, impact of the project, savings, career story).

For improved uptake at national department level, direct channels between the WRC CEO and DG would be valuable to share and present policy briefings and advice on how the product can support legislation and policy. Participants confirmed that not all products that would directly benefit DWS, for example, are reaching the top echelons of management.

Ideally, RDI projects should find a suitable partner to ensure that the WRC project transition into a partner project. Mechanisms include: 1) identifying such a partner/stakeholder at concept phase, someone with interest and need to get the product to the end-user, and 2) sharing information after project close out until such a partner takes interest and ownership.

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Chapter 5: Monitoring and evaluation tool

5.1 PURPOSE AND FUNCTIONALITY OF THE TOOL

This chapter discusses in more detail the proposed M&E Tool. As mentioned before, this Tool will monitor and evaluate stakeholder value across the full project life cycle. The Tool draws data from the WRC's existing but adapted PME tools:

- Data from the Inception Phase, that is data from the final project proposal, including the U&IP, and the Consolidated Review, forms the baseline data. The baseline data expresses **the potential stakeholder value of the project**.
- Data from the Completion and Reflection Phases represents the project's actual performance. This includes data from the Project Leader's report[4], the Research Manager's report, the Reference Group report and the Debrief at Reflection Phase. This data therefore expresses **the actual stakeholder value of the project**.

The figure below illustrates this process:

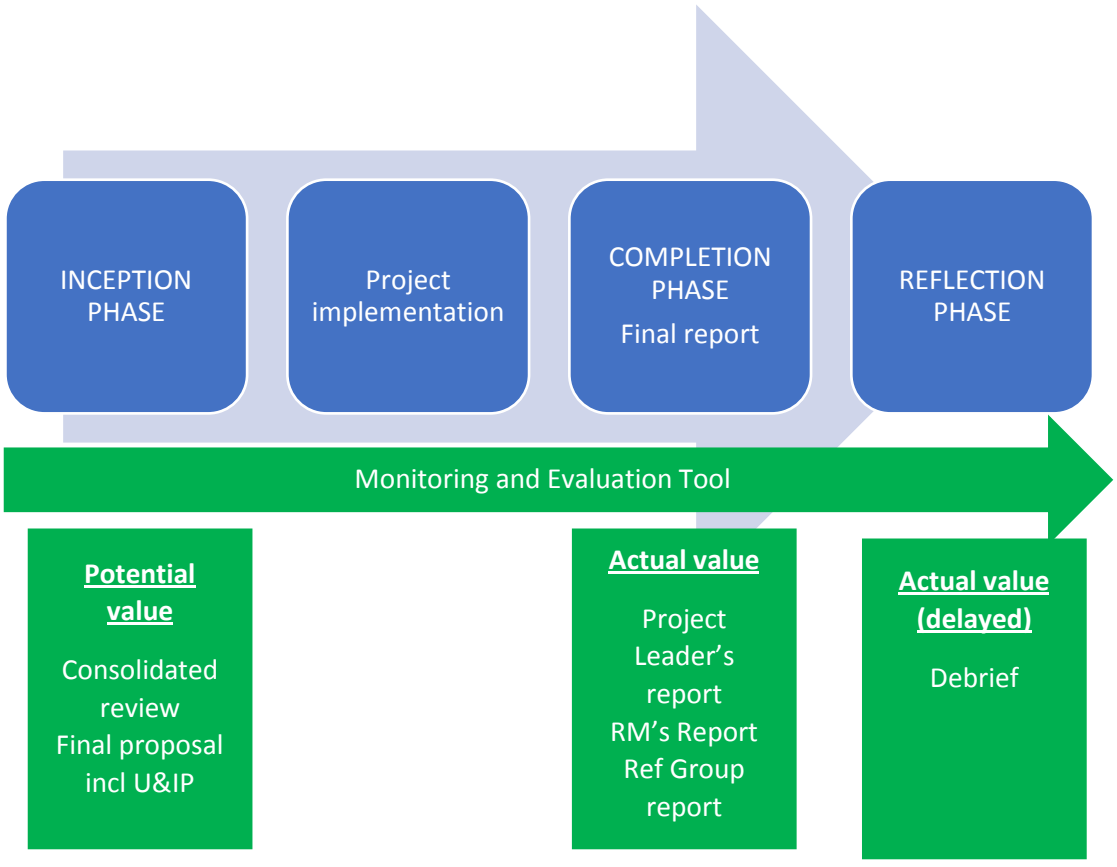


Figure 5.1: Monitoring and Evaluation tool – source of data per Project Phase

In addition to the above, it is proposed that data from the final proposal populate a **project profile,** which also forms part of the M&E tool.

[4] It was proposed in 5.4.2 that the current New Knowledge report be replaced with a Project Leader's report that includes the U&IP report.

Table 5.1: Project profile

Project Name	Name
Project number	Number
Duration	Years
KSA, Thrust, Programme	KSA
	Thrust
	Programme
Lead organisation	Name
	Type
	HDI info
Collaborating organisation	Name
	HDI info
Part of an MoU	Yes/No
Innovation category	Technological/Non-technological
	Type of innovation
Technology Readiness Level (if relevant)	TRL
Co-funder (if relevant)	Name
	% of budget
Budget summary	Amounts
Intended users and beneficiaries	Specify
Impact in terms of Knowledge Tree and Lighthouses	As in project proposal

5.2 THE METRICS OF THE M&E TOOL

The metrics of the M&E Tool was derived from the table that maps core stakeholder values, subcategories, and indicators (Table 3.1). Columns were added for the three phases: Inception, Completion and Reflection, and the source of the data is indicated.

The following abbreviations are used in this table, which follows on the next page:

- RM = Research Manager
- U&IP = Uptake & Impact Plan
- PL = Project Leader
- Ref Group = Reference Group
- Ext = External

Legend
Red text refers to the current, or new, PME tool from where the cell will be populated. Light grey cells in Inception Phase mean ''cannot be planned at Inception Phase''/no information available at Inception Phase. Dark grey cells mean ''not further tracked'' in Reflection Phase.

The tool was developed in Excel to test data capturing and calculations.

Table 5.2: Metrics of the Monitoring & Evaluation Tool

VALUE CATEGORY Value / Benefit	Description of value indicator	Metrics	Inception Phase	Completion Phase	Reflection Phase
Sector solutions					
Improved sector performance	The project outputs contribute to improved sector performance in one or more of the areas below.	Likert scale	Proposal; Consolidated review	RM's report' Ref Group report	Debrief
	The project outputs facilitate improved **policies and decision making**	Qualitative; description	Proposal; Consolidated review	RM's report' Ref Group report	Debrief
	The project outputs contribute to improved **water resources and/or environment**	Qualitative; description	Proposal; Consolidated review	RM's report' Ref Group report	Debrief
	The project outputs contribute to improved **water services (water supply and sanitation)** Examples: reduction in costs; improved processes; improved equity	Qualitative; description	Proposal; Consolidated review	RM's report' Ref Group report	Debrief
	The project outputs contribute to improved **water use in agriculture, incl water re-use**	Qualitative; description	Proposal; Consolidated review	RM's report' Ref Group report	Debrief
	The project outputs contribute to improved **water use in industry & mining, incl water re-use**	Qualitative; description	Proposal; Consolidated review	RM's report' Ref Group report	Debrief
	The project outputs contribute to improved **energy management**	Qualitative; description	Proposal; Consolidated review	RM's report' Ref Group report	Debrief

VALUE CATEGORY Value / Benefit	Description of value indicator	Metrics	Inception Phase	Completion Phase	Reflection Phase
Cross-cutting socioeconomic benefits	For example, increased income, jobs, start-ups, access to health services, markets, transport, business, education	Likert scale	Proposal; Consolidated review	RM's report' Ref Group report	Debrief
Stakeholder solutions					
Stakeholder solutions	Project delivers challenge-specific value to stakeholders	Qualitative Likert scale	Proposal; Consolidated review	RM's report' Ref Group report	Debrief
Uptake and Impact					
Planning for Uptake and Impact	The project achieves its "Planning for Uptake and Impact objectives" [See-project-specific indicators in Uptake & Impact Plan]	Project-specific	Uptake & Impact Plan and Report		Debrief
Knowledge exchange	The project includes knowledge exchange activities	Qualitative Likert scale Quantitative numbers	Proposal; Consolidated review	RM's report' Ref Group report	Debrief
Learnings for future research	The project process includes the opportunity to reflect on lessons learnt and opportunities for future research.	Qualitative		Reflective section in project report RM's report	Debrief
(If relevant) Knowledge application and/or commercialisation	The knowledge or products that the project has produced will be applied or commercialised.	Qualitative Likert scale Description	Proposal; Consolidated review	RM's report' Ref Group report	Debrief
(If relevant) Technology Readiness Level	The TRL level of the technology produced in this project	Actual TRL	Proposal	PL's report	Debrief
Quality					
People	Project leader has excellent track record; research rating, and recognised experience	Qualitative Likert scale:	CV; references; NRF research rating (proposal, RM score in Consolidated review)	performance in project (RM & Ref Group report)	

VALUE CATEGORY Value / Benefit	Description of value indicator	Metrics	Inception Phase	Completion Phase	Reflection Phase
	Project team members has excellent track record, research rating, and recognised experience	Qualitative Likert scale	CV; references; NRF research rating (proposal, RM score in Consolidated review);	performance in project (RM & Ref Group report)	
Processes and deliverables	Scientific/Technical soundness and credibility (aims, methodology, deliverables)	Qualitative Likert scale	Proposal; Consolidated review	RM's report' Ref Group report	
	Project follows innovative approach and/or delivers innovative products	Qualitative Likert scale	Proposal; Consolidated review	RM's report' Ref Group report	
	Value for money (budget & timeframe appropriate for aims, methodology and deliverables; outcomes and expected impact)	Qualitative Likert scale	Proposal; Consolidated review	RM's report; Ref Group report	
Knowledge outputs	Research outputs are held in high regard because of quality and innovativeness Examples of outputs: publications, conference papers, briefs and commercial products.	Quantitative Numbers	Planned: Publications in peer-reviewed journals	Achieved: Publications in peer-reviewed journals	Final achieved: Publications in peer-reviewed journals
		Quantitative Numbers	Planned: Articles in trade magazines and popular magazines	Achieved: Articles in trade magazines and popular magazines	Final achieved: Articles in trade magazines and popular magazines
		Quantitative Numbers	Planned: Standalone publication like a booklet or guideline	Achieved: Standalone publication like a booklet or guideline	Final achieved: Standalone publication like a booklet or guideline
		Quantitative Numbers	Planned: Policy, Ministerial, etc. briefs; working papers	Achieved: Policy, Ministerial, etc. briefs; working papers	Final achieved: Policy, Ministerial, etc. briefs; working papers
		Quantitative Numbers	Planned: Conference presentations	Achieved: Conference presentations	Final achieved: Conference presentations

VALUE CATEGORY Value / Benefit	Description of value indicator	Metrics	Inception Phase	Completion Phase	Reflection Phase
		Quantitative Numbers	Planned: If commercial potential: Registration of patents, trademarks, licences, designs	Achieved: If commercial potential: Registration of patents, trademarks, licences, designs	Final achieved: If commercial potential: Registration of patents, trademarks, licences, designs
Recognition	The project outputs and/or team receive recognition	Quantitative Numbers		Achieved: Awards related to project	Final achieved: Awards related to project
		Quantitative Numbers		Achieved: Speaker invitations related to project	Final achieved: Speaker invitations related to project
		Quantitative Numbers		Achieved: Citations	Final achieved: Citations
		Quantitative Numbers		Achieved: Invitation to contribute to a book	Final achieved: Invitation to contribute to a book
Collaboration					
Stakeholder engagement	Project led to institutionalised relationship/MoU	Quantitative Numbers		Achieved: MoU or other form of institutionalised relationship	Final achieved: MoU or other form of institutionalised relationship
	Users and/or beneficiaries are part of the project team or Ref Group	Qualitative Likert scale	Project proposal; Consolidated review	RM's report Ref Group report	
	Users and/or beneficiaries get the opportunity to comment on deliverables or products	Included in above	Project proposal; Consolidated review	RM's report Ref Group report	
Capacity building					

VALUE CATEGORY Value / Benefit	Description of value indicator	Metrics	Inception Phase	Completion Phase	Reflection Phase
Capacity building and career advancement	The project contributes to capacity building incl institutional and community development	Qualitative Likert scale	Proposal; Consolidated review	RM & Ref Group reports	Debrief
	The project contributes to post-graduate qualifications	Quantitative numbers	Proposal Planned	PL's report Achieved	Debrief Final achieved
	The project advances the career(s) of the project team	Qualitative		PL's report	Debrief
	The project offers training for users and/or beneficiaries	Quantitative numbers	Proposal Planned	PL's report Achieved	Debrief Final achieved
Networking and learning					
Networking and learning	Project leads to spin-off projects or other initiatives for the Project Leader and/or team			Achieved PL's report	Final achieved Debrief
	Project leads to spin-off projects or other initiatives for the Reference Group			Achieved Ref Group report	Final achieved Debrief
	Ref Group members report positively on the networking opportunities that the project offered	Likert scale		Ref Group report	
	Ref Group report positively on the learning opportunities that the project offered	Likert scale		Ref Group report	

5.3 QUALITATIVE AND QUANTITATIVE METRICS

In this section, we will discuss the metrics of the stakeholder value indicators, as presented in the table above, in more depth.

The metrics are **qualitative and quantitative**. The qualitative metrics are based on the subjective views of the Research Manager, the external reviewers and the Reference Group members.

5.3.1 Qualitative metrics

In the WRC's current PME tools, these qualitative assessments are expressed as a score on a 5-point Likert scale with qualitative comments. Below is an example from the external reviewer's report template:

INNOVATION

Comments: *(please use the following issues as a guide to present a short and focused assessment)*

- *Is the proposal based on new scientific/technical approaches and ideas?*
- *What potential exists for the research to lead to new approaches in existing practice and/or technology, or the creation of completely new technology?*

Comments:

Score: *(considering the comments given above please tick the appropriate box)*

In terms of innovation, the proposal

fails completely	*fails in most respects*	*succeeds in most respects*	*succeeds completely*	*exceeds expectations*
1	**2**	**3**	**4**	**5**

Figure 5.2: Example from external reviewer's report template

At Inception, project proposals are usually adapted and improved to incorporate the external reviewers and the Research Manager's assessments. **The scores at Inception Phase should therefore be updated to reflect these adaptations and improvements.** As the final proposal does not go back to the reviewers, this would be the task of the Research Manager.

At the Reflection Phase, it would again be the task of the Research Manager to update the final Research Manager's report to provide for outputs, uptake and impact that realised between Completion and Reflection.

Ideally, Reference Group members representing research partners, end-users and beneficiaries should be present at the debrief session so that the Reference Group report could similarly be updated as necessary.

5.3.2 Quantitative metrics

The quantitative metrics track the planned (where relevant) and the actual numerical values of project outputs like products, registrations, publications, conference papers, training events, knowledge sharing activities, etc. across the three project phases. See the table below for an example.

Table 5.3: Example of quantitative metrics across the three project phases

Core Stakeholder value	Indicator	Inception	Completion	Reflection
Quality	No or articles in DHET accredited journals	# planned or NA	# published	# published
Capacity building	No of postgraduate qualifications	# planned (Honours, Masters, Doctorates)	# achieved # in progress	# achieved

At Inception, the final approved project proposal will be the source of information on the relevance of the indicators and their planned numerical values. At Completion, the source of information on the actual achieved numbers will be the Project Leader's report. At Reflection, the Project Leader will have to update this report to reflect outputs that have realised between Completion and Reflection.

5.3.3 The metrics of the Uptake & Impact Plan

The Uptake & Impact Plan is project-specific, which means that its indicators and metrics are also project-specific. It is likely that the U&IPs would include both qualitative and quantitative metrics.

At Inception, the Uptake & Impact Plan would reflect planned performance on the indicators. The Uptake & Impact report, which is proposed to form part of the Project Leader's report, would reflect actual performance on the uptake and impact indicators at Completion. This report will also have to be updated at Reflection to include uptake and impact that have realised between Completion and Reflection.

5.4 THE RELIABILITY OF THE METRICS

The reliability of the qualitative metrics will depend on the consistency and clarity of the questions that the external reviewers, Research Managers and Reference Group members are asked to answer in the respective PME tools:

- The questions that relate to the indicators should be easy to understand and easy to answer. This will facilitate a common understanding of what each core value means and what should be considered as indicators that this value has realised. Explanatory notes in the tools or a link to a short explanatory video should contribute to the reliability of the responses.
- If the qualitative metrics will be used to compare a project's expected performance at Inception Phase with actual performance at Completion and Reflection, the questions should be the same or similar.

The reliability of the quantitative information that the Project Leader provides on actual outputs at Completion and Reflection will depend on the supporting evidence. For example, attendance

registers for knowledge sharing workshops or a full reference for an article in a DHET accredited journal. The PME templates will therefore have to indicate what supporting evidence is required.

Since Research Managers and Project Leaders have a vested interest in the success of their projects, the assessments of independent external reviewers and Reference Group members are critical to ensure the reliability of the metrics. This underlines the importance that research partners, end-users, and/or beneficiaries are represented in reviewing teams and Reference Groups.

5.5 INSIGHTS THAT THE M&E TOOL CAN PROVIDE

The proposed M&E Tool would provide the research institution with a rich diversity of insights that can be used for multiple management and reporting purposes. For example:

Monitoring and evaluating project performance:

1. The Tool can be used to **track and monitor project performance** across the full lifecycle of a project, by:
    a. Comparing the scores of the qualitative assessments at Inception Phase with the scores of the qualitative assessments at Completion Phase (and the revised scores at Reflection where relevant).
    b. Comparing planned numbers with actual achieved numbers at Completion and Reflection Phases.

    These comparisons will enable the WRC to identify the areas where a project has performed more, or less, satisfactorily than expected, or less than planned, plus the areas in which it has excelled.

    It will also provide the WRC with information on which indicators only realise after Completion, and within which timeframe.

2. At Completion Phase, the Tool can be used to **evaluate a project's <u>actual</u> performance** in terms of each of the core stakeholder values and their indicators, and collectively across all seven core values.
3. At Reflection Phase, all data on the actual achieved output numbers can be summarised.

Comparing performance across projects:

1. The project-specific information, including the information in the Project Profile, can be collated to compare projects in terms of the final qualitative assessments at Completion and the actual achieved outputs (numbers). Both insights could be used for **benchmarking purposes** to determine what is realistic to expect in terms of quality and outputs for different types of projects.
2. The collated actual achieved outputs (numbers) can be used as input into the WRC's KPIs, which will enable the institution to report on actual outputs in terms of the core stakeholder values.

The metrics of the project-specific Uptake & Impact Plan will provide similar insights for uptake and impact.

5.6 INSIGHTS ILLUSTRATED

Below are some examples of how the insights from the M&E Tool could be depicted. Please note that the tables are illustrative and not necessarily complete.

5.6.1 Project-specific insights

5.6.1.1 Monitoring and tracking outputs across Phases

Comparing outputs across the three Phases will enable the research institution to monitoring and track outputs, as illustrated in the table below.

Table 5.4: Monitoring and tracking quantitative outputs across project phases

VALUE CATEGORY Value / Benefit	Description of value indicator	Planned number at inception	Achieved Planned number at Completion	Achieved number at Reflection
Sector solutions	**Not quantitative**			
Stakeholder solutions	**Not quantitative**			
Uptake and Impact				
Planning for Uptake and Impact	[See-project-specific indicators in Uptake & Impact Plan]			
Knowledge exchange	No of knowledge exchange activities			
Quality				
Research outputs	No of peer-reviewed articles in DHET accredited journals			
	No of articles in trade or popular magazines			
	No of other publications like booklets or guides			
	No of briefs, like ministerial briefs, policy briefs, working papers			
	No of conference presentations (international)			
	No of conference presentations (national or local)			
	If aiming to be commercialised: No of registered trademarks, patents, licences, designs			
Collaboration	**Not quantitative**			
Capacity building				
Capacity building and career advancement	No of post-graduate qualifications (Honours),			
	No of post-graduate qualifications (Masters)			
	No of post-graduate qualifications (PhD)			
	No of HDI persons who achieved postgraduate qualifications			
	No of training sessions			

VALUE CATEGORY Value / Benefit	Description of value indicator	Planned number at inception	Achieved Planned number at Completion	Achieved number at Reflection
Networking and learning	**Not quantitative**			

The changes in the numerical values across the three Phases can be translated into a simple Likert scale or a colour code for further analysis and/or benchmarking purposes.

Performance	Score	Colour
Achieved less than planned	1	
Achieved as planned	2	
Achieved more than planned	3	

Further analysis could include the reasons for achieving more, or less, than planned and the type of outputs that deliver as, or more, than planned.

Similarly, the scores of the qualitative assessments of potential project performance as reflected in the Consolidated Review could be compared with scores at the Completion Phase with the purpose of identifying reasons for improved or declined performance.

5.6.1.2 Qualitative evaluation at Completion Phase

This evaluation is based on the 5-point Likert scale scores in the RM's report and the Ref Group report for each of the core values and their indicators.

fails completely	*fails in most respects*	*succeeds in most respects*	*succeeds completely*	*exceeds expectations*
1	**2**	**3**	**4**	**5**

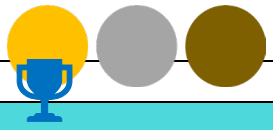
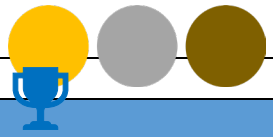
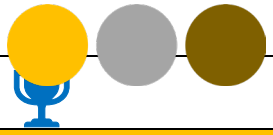
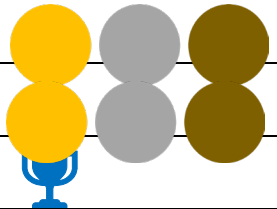
The score on the 5-point Likert scale can be converted to three icons:

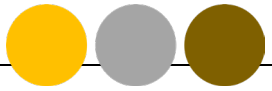
Score	Icon	Meaning
4 or 5		Excellent
3		Good
1 or 2		Disappointing

Special achievements receive a badge or a trophy. 

A project can therefore score a gold, silver or bronze, or a trophy as illustrated below:

Table 5.5: Summative insights illustrated

Sector Solutions -		
Sector solutions	Project contributed to improved sector performance in one or more areas	
	The sector solution became official policy or gazetted	
Challenge-specific solutions		
Challenge-specific solutions	Project delivered challenge-specific solutions to stakeholders	
	The solution is used to address the challenge.	
Uptake & Impact		
Uptake & Impact	The knowledge or products that the project has produced is used/ commercialised	
	Impact story	
Quality		
People	Project Leader performance	
	Project team performance	
Processes and deliverables	Project was scientifically/technically sound and credible (in terms of aims, methodology, deliverables)	
	Project followed innovative approach and or delivers innovative products	
	Project delivered value for money	
Recognition	Citations, book chapters, keynote invitations, awards	
Collaboration		
Stakeholder engagement	End-users and beneficiaries involved in Project team and/or Reference Group	
	End-users and beneficiaries got the opportunity to comment on deliverables and/or products	
	Led to MoU or another type of collaboration between WRC and research partner)	
Capacity building		

Capacity building	Project contributed to capacity building including institutional and/or community development	
Networking and learning		
Networking & Learning	Ref Group reported positively on networking and learning opportunities	
	Spin-off projects for Ref Group	
	Spin-off projects for Research Team	

Performance summary

The performance of a project on the above stakeholder values and indicators can be summarised as follows

TOTALS:

			
(No of trophies)	(No)	(No)	(No)
Details	details	details	details

The project performance could also be summarised per theme. For example:

EFFECT/IMPACT (Sector solutions, stakeholder solutions, Capacity building, Uptake & Impact):

			
(No of trophies)	(No)	(No)	(No)
Details	details	details	details

STAKEHOLDER ENGAGEMENT (Collaboration and Networking & Learning):

			
(No of trophies)	(No)	(No)	(No)
Details	details	details	details

EXCELLENCE (Quality):

			
(No of trophies)	(No)	(No)	(No)
Details	details	details	details

The analysis per theme will highlight the strengths and weaknesses of project performance. For example, some projects might do very well in the Excellence theme but be evaluated less favourably in Stakeholder Engagement or Effect/Impact.

5.6.1.3 Final output statistics at Reflection Phase

The metric scores quantitative indicators as follows:

- As a number value (for example, number of publications, number of knowledge-sharing activities)
- As N/A (not applicable) for this project.

The table below illustrates what a summary of the final output numbers at Reflection Phase could look like.

Table 5.6: Example of a summary of quantifiable outputs

VALUE CATEGORY **Value / Benefit**	**Description of value indicator**	**Number**
Stakeholder solutions	**Not quantitative**	
Uptake and Impact		
Planning for Uptake and Impact	[See-project-specific indicators in Uptake & Impact Plan]	
Knowledge exchange	No of knowledge exchange activities	
	No of participants	
Quality		
Research outputs	No of peer-reviewed articles in DHET accredited journals	
	No of articles in trade or popular magazines	
	No of other publications like booklets or guides	
	No of briefs, like ministerial briefs, policy briefs, working papers	
	No of conference presentations (international)	
	No of conference presentations (national or local)	
	If commercialisation is the purpose: No of registered trademarks, patents, licences, designs	
	No of Technology Development Reports, Concept Papers, blueprints (if relevant	
Recognition	No of speaker invitations, awards, citations, invitations to contribute to a book	
Collaboration	**Not quantitative**	
Capacity building		
Capacity building and career advancement	No of post-graduate qualifications (Honours),	
	No of post-graduate qualifications (Masters)	

VALUE CATEGORY Value / Benefit	Description of value indicator	Number
	No of post-graduate qualifications (PhD)	
	No of HDI persons who achieved postgraduate qualifications	
	No of training sessions (accredited training or CPD-earning)	
Networking and learning	**Not quantitative**	

Without a benchmark figure for the project type, it would be very difficult to evaluate the output numbers as excellent, good or disappointing. However, using the M&E Tool to track project output numbers for each of the core stakeholder values over 3-5 years should provide statistics for such a benchmark.

5.6.1.4 Final project evaluation

The final project evaluation would therefore comprise:

1. The project profile
2. The scores on the final RM's and the Reference Group reports
3. The output statistics at Reflection, and
4. The Uptake & Impact report as updated at Reflection.

5.6.2 Grouping project insights

Project-specific insights can be grouped in many ways to give a range of insights:

- The performance of individual Project Leaders across projects
- The performance of different types of projects, for example, technological versus non-technological projects, projects led by an academic team versus a consultancy team
- The performance of an RM's portfolio of projects
- The performance of KSAs' portfolio of projects
- The performance of short-term versus long-term projects
- The performance of follow-up projects in comparison with the original project.

5.6.3 Insights across projects

Project data can be collated from the M&E Tool for reporting purposes. For example, in financial year X/Y, the WRC completed # projects with the following statistics in terms of the stakeholder value that was delivered:

1) # technological innovations; # non-technological innovations
2) Stakeholder solutions:
   a) # projects delivered challenge-specific solutions to stakeholders with 1-2 impact or innovation stories to illustrate.
3) Sector Solutions:
   a) # projects delivered Policy and product development solutions
   b) # projects delivered Water Ecosystems solutions
   c) # projects delivered Water Services (Water Supply & Sanitation) solutions
   d) # projects delivered Agricultural Water Use solutions
   e) # projects delivered Industrial Water Use solutions

f) # projects delivered Energy solutions
g) # projects delivered cross-cutting socio-economic benefits, for example increased income, jobs, start-ups, access to health services, markets, transport, etc.

4) Uptake & Impact
   a) # projects achieved their uptake and impact objectives
5) Quality:
   a) # of our Project Leaders had NRF ratings of 3 and above; Y had Google Scholar ratings of ….
   b) # research reports were published on our website
   c) # peer-reviewed articles were published in DHET accredited journals; # in industry journals
   d) # conference papers were delivered, based on WRC research
   e) # patents, Y trademarks, etc. were registered
   f) # projects or Project Leaders received national or international awards.
6) Collaboration:
   a) # projects were co-funded. The average co-funding was #% of the project value.

5.7 DATA CAPTURING

It is proposed that all the WRC's PME tools, with the proposed alignment with stakeholder value, use the same template format. These templates could eventually be web-based and integrated into the proposed monitoring and evaluation tool.

It is also proposed that the two new tools, the Monitoring & Evaluation tool, and the Uptake & Impact Plan and report, be web-based. Project Leaders, Researchers Managers, external reviewers, and Reference Group members can then populate the relevant data fields as the project is rolled out from Inception until Reflection.

If all the PME tools are web-based, data can directly feed into the Monitoring & Evaluation tool, and from there, the M&E tool can do the required analysis to produce the insights.

In the interim, the WRC could use Google forms for its PME functions, which feed into a Google sheet at the back end.

Below is a screen shot from an updated Consolidated Review that has been converted into a Google form:

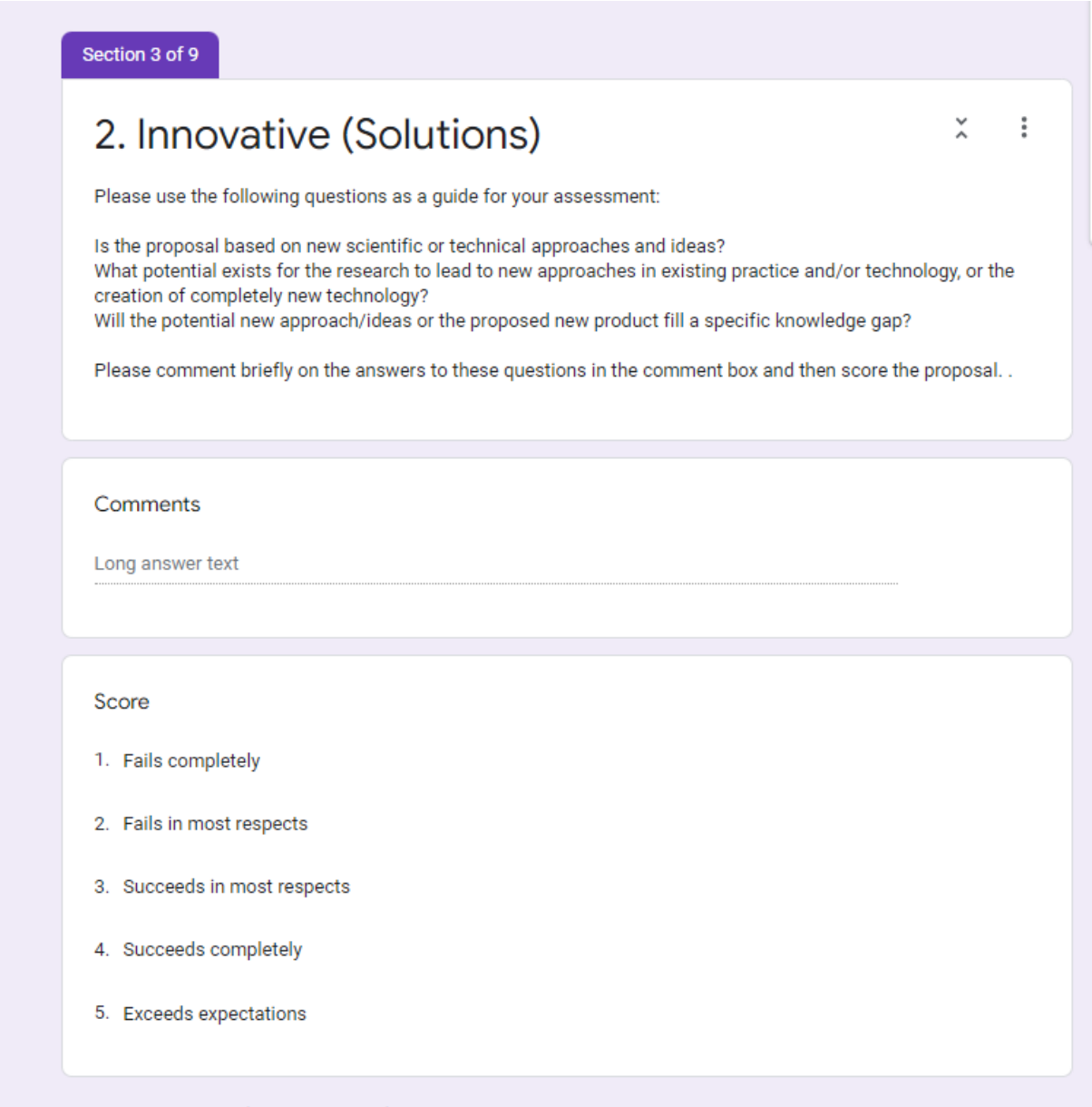


Figure 5.3: Screen shot of updated Consolidated Review in Google Forms

When populated with data from three test reviewers and one test Research Manager, the Google form generates a report. Below is a screen shot from the report that was generated:

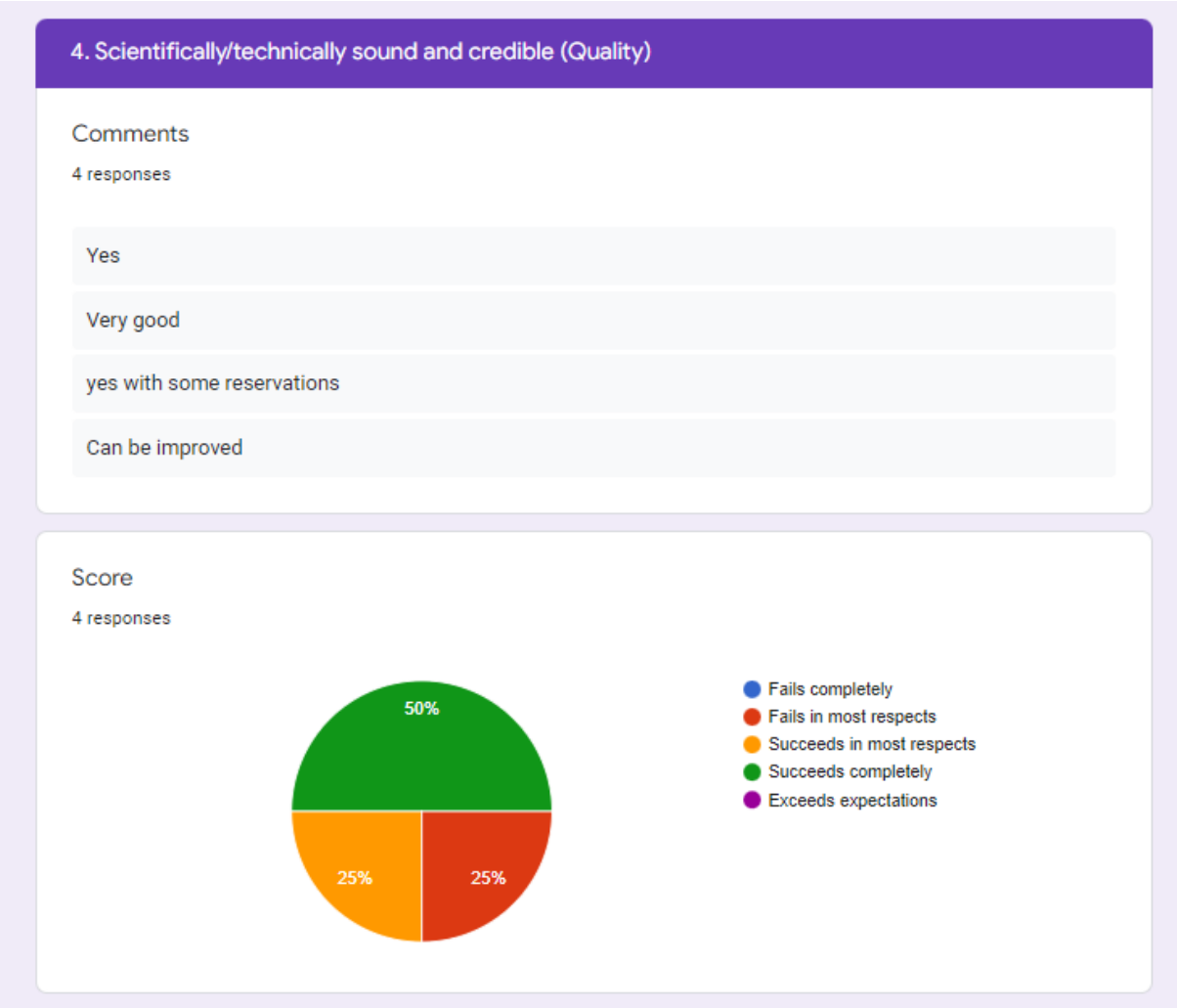


Figure 5.4: Screenshot of report that Google Forms generates

PME tools in Word or Excel are alternatives, but the task to collate data from the different tools would be manual and therefore more cumbersome.

Chapter 6: Conclusions and recommendations

6.1 STAKEHOLDER VALUE AS THE GOAL

The Terms of Reference stated that this project should develop a framework and tool that will enable research institutions to plan, monitor and assess the value that RDI delivers to stakeholders.

The first round of stakeholder engagements, coupled with insights from previous WRC research and the literature, found stakeholder value to be multifaceted and different from different stakeholder perspectives. Whereas South African research institutions tend to regard uptake and impact as the ultimate value that RDI projects deliver, stakeholders have a much more nuanced perspective on the value that RDI projects deliver.

Seven core values could be derived: quality, collaboration, capacity building, networking and learning, sector solutions, challenge-specific stakeholder solutions, and uptake and impact. It should be emphasised though that uptake and impact run across the other core values. For example, if a stakeholder perceives an RDI output as a solution, it implies that they will use it (take it up), and by using it, the knowledge will have impact of some kind.

The research found that there was a good match between the WRC's current project performance indicators and the stakeholder value indicators. However, the alignment between the stakeholder value indicators and the KPIs of the WRC can be improved.

6.2 UNLOCKING STAKEHOLDER VALUE FOR END-USERS AND BENEFICIARIES

The literature review and the first round of stakeholder engagement research found that the value or benefit of RDI differs from project to project for end-users and beneficiaries. Apart from the general thrust of being ''usable'' or ''beneficial'', or ''offering a solution'', the value is project specific.

For this reason, the Value Framework proposes a new PME tool to actively plan uptake and impact by engaging with end-users and beneficiaries to make them aware of, and capacitate them to apply, the project-specific value or benefits. The proposed Uptake & Impact Plan (U&IP) is project-specific and sets its own SMART indicators.

The proposed U&IP is furthermore an opportunity to leverage resources and expertise towards realising uptake and impact. Planning for uptake and impact is therefore proposed as a collaborative activity between the Project Leader, the WRC's Business Development & Innovation division, the Research Manager and representatives of end-users and/or beneficiaries.

Project Leaders are often hesitant to commit to uptake and impact objectives because they do not control the variables that determine the outcome. For example, a crisis or new regulations or even a new Director in the right division can trigger the uptake of specific RDI products. This was confirmed in the second round of stakeholder research. On the other hand, the same Project Leaders also confirmed that they are keen to achieve uptake and impact because it would render their projects useful and successful.

The rollout of the U&IP should take note of both these sentiments.

Developing a full-scale U&IP for each research project might not be feasible. However, there would be the opportunity to group projects with the same end-users or beneficiaries together. This, in turn, would address the need that stakeholders expressed for a mechanism to coordinate research and to inform research partners of new knowledge and products in the pipeline.

6.3 MONITORING AND EVALUATING STAKEHOLDER VALUE

Ideally, a research institution should plan, monitor, and evaluate stakeholder value across all project phases, including what is called the Reflection Phase in this study, which extends to 3-5 years beyond the end date of the project. Only in considering all these phases, will the research institution be able to get a full picture of a research project's performance and the stakeholder value that it has delivered.

The proposed Value Framework will empower the WRC to do exactly this by:

- Adapting existing PME tools to align them with the core stakeholder values and their associated performance indicators.
- Adding a monitoring and evaluation tool that can:
    - track and report stakeholder value across all project phases
    - analyse performance data in each of the phases, and take the necessary corrective actions
    - benchmark performance in terms of stakeholder value for different project categories; and
    - collate performance data to feed into the WRC's KPIs.

It was proposed that all the PME tools use the same template format, which eventually could be web-based and integrated into the proposed monitoring and evaluation tool.

The value that certain stakeholder groups attach to water RDI might change over time. This will have to be captured in regular stakeholder research and the Framework adjusted accordingly.

6.4 PILOTING THE UPTAKE & IMPACT PLAN

It is recommended that the U&IP be piloted with a sample of new WRC projects. This will give the WRC, and its GWRC partners, the opportunity to test which aspects of the U&IP are feasible and work well, and which should be revised.

6.5 OPPORTUNITIES

In the previous chapter, some of the insights that the proposed RDI Value Framework can offer were illustrated and discussed. Implementing the Framework would furthermore offer the opportunity to:

- **Use the M&E tool for further analysis**. For example:
    - A SWOT analysis of project performance
    - A sensitivity analysis (that is, identifying the factors that have potentially the biggest impact on a research project) and a quality risk assessment (potential adverse effects and a risk matrix). The sensitivity analysis should show which variables are affected by adverse effects and how.

- Adapting the WRC's benchmark expectation of project outputs accordingly. These results can be shared with the GWRC members.
- Adapting the M&E tool according to the benchmark results.

- **Align institutional KPIs with stakeholder value and indicators** to empower the WRC to report directly on expected stakeholder value, and
- **Report into national and global innovation indices**.

6.6 CHALLENGES

System functionality is probably a challenge that all research institutions deal with, but it is also a critical success factor of implementing the proposed RDI framework.

The implementation will also require human resources. However, this challenge creates a unique capacity building opportunity that will add significant value to the WRC's operations and potentially also to those of its GWRC partners.

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Appendices

APPENDIX A:
AGENDA AND DISCUSSION GUIDE FOR SECOND ROUND OF STAKEHOLDER RESEARCH

Agenda

INTERVIEW AGENDA (MsTeams meeting): Estimated time 1- 1.5 hours

- Opening by WRC researcher (Dr Marlene vd Merwe-Botha)
- Presentation of the Evaluation Framework (7 slides)
- Discussion and input by:
    - Project Manager
    - Reference Group Member
    - Student
- Presentation of Metric Tool and algorithm (condensed)
- Data collection: Table hereunder.
- WRC Acknowledgement of Contribution.

Discussion guide

ToR and Proposal Stage:

Project Leads / Ref Member / Student:

a. Will the green steps and proposed inserts manage to set the project up for U&I?
b. Refer list of Indicators: Is there any other indicator that you would include? Reason?
c. Any indicator that that you would take out? Reason?

Project Leads:

a. Are there any indicators that were not relevant/applicable for your project? Reason?
b. How do you decide what you will commit to in a proposal: patent or licence, how many students, which qualifications, how many papers, how many stakeholder activities, how many other capacity building activities, etc.?
c. Tracking your commitment
    - what did the project eventually deliver? (end of session or complete Table own time)
    - what is realistic to expect from Project Leaders?
    - what is a realistic time frame – to plan for I&U, to review progress against indicators?

Proposal Review Stage

Project Leads & Ref Group Member:

a. Do you see value in updating / replacing the existing Proposal review method with the proposed approach?

b. What indicator to measure if the project will deliver value for money? (Are the benefits measurable? Benefits exceed money value?)
c. At reference group level, is this project review and inception indicators of value during project kick-off?
d. Are there any particular indicators under the Value Categories you want the external reviewer to consider?

Student:

a. At project proposal and inception level, what are the key indicators that will set the project up for maximum student participation and growth?

Inception and Uptake & Impact Planning Phase

Project Leads:

a. Would targeted uptake and impact planning have been useful for your project? Looking back...
b. Which of these steps did you actively follow in your project?
c. Which of these would have been helpful to facilitate or enhance uptake and impact?
d. What would you have identified for your project as SMART indicators of uptake and impact?
e. What mechanisms would you have set up to monitor and evaluate uptake and impact indicators during the project cycle?
f. How would you have liked to market the value that your project generated?

Completion and Reflection Phases

Project Leads:

a. At project completion phase, could you report on all the outputs of the project, e.g. patents, licences, publications, qualifications, spinoff projects and career advancement that happened as a result of the project?
b. Will a mid-project review be useful to your project?
c. Will it be valuable to have a metric for a projection completion review?
d. If your project has one, is it aligned with the indictors proposed?
e. Will it be useful to see how your project performed at the end of the project?
f. And after 3-5 years? Reasons?
g. Is it realistic to expect PMs to complete both metrics at this phase?
h. Will PMs have the information?
i. Will the information be useful to the WRC to report on performance of the project, specifically to the U&I of their projects?

Student:

a. At project completion phase, could you report on your qualification, publications and career advancement that resulted from the project?
b. If not, what would be a realistic timeframe? How many years beyond project completion?
c. Do you think it is realistic to expect students to report this information to the WRC?
d. If not, how should the WRC get hold of the information?

APPENDIX B:
SECOND ROUND OF STAKEHOLDER RESEARCH

Project 1: Data Magic software

General

- Consideration of the ''end-user' must be emphasized in the Framework, as this is the ultimate realisation of the benefit to the stakeholder. In the case of Data Magic, the stakeholders were Umgeni Water, Johannesburg Water, Rand Water, and other water boards, the end-users would be the communities/customers receiving quality water.

Evaluation across different phases

- The team liked the Inception Phase and Planning for Value, as it provides upfront goals to measure, test data and use collected data.
- A preparatory meeting before the project start is important, as it serves to define clear goals, and agree on the roadmap. It is important to target specific people to represent the end-user. For Data Magic, training came in after-fact and was not planned. By introducing the Inception Phase, such events can be planned and costed.
- Reflection Phase: A 3-to-5-year review is a must.

Indicators

- IP is part of knowledge and must come to the fore as an indicator, as opposed to listing only commercialisation aspects – e.g. Data Magic is public good and hold potential to grow knowledge. Noting – it is hard to measure IP.
- U&I must identify outputs – the set of indicators provide guidance to conceptualise such outputs, that will become measurables. Some flexibility must be built in, to allow for occurrences such as COVID, which impacted on Data Magic.
- An indicator to expand is workshops. This must continue beyond the project completion phase to ensure replication and reaffirmation to optimise uptake and impact.
- Add more indicators to target conferences that publish proceedings – this is an important imperative in the academic sector.
  Drivers/decisions for the Data Magic project were driven by impact on water quality and environment. It would not have been possible to set targets on country level as it would involve complex indicators such as country wealth, health, culture, capex, GDP, etc. The Data Magic project is still ongoing and shows its value in improving compliance and performance.
- A valuable opportunity (indicator?) would be if a project such as Data Magic could link up and add value or support the Blue Drop program or IRIS. This would affect a broader impact via linkages with products that have similar objectives – linkages or the potential to link could be an indicator.
- Practical workshops for tools and free software are important indicators. Again, 1-2 workshops do not suffice, the awareness, uptake and understanding (and USE) matures over time, mostly after the Completion Phase.
- Value for money is difficult to measure, even for Data Magic. UK has recently commissioned a project to investigate this notion, but it comprises of RoI, economies, tools, capex/opex and a variety of factors are involved. A future WRC study may be commissioned for this indicator. The importance is captured in the essence of 'making good decisions".

- More case studies (and WIN-SA lessons) must feature as indicators – these are often relevant only after project completion as it takes time to implement a product. The indicators should be # published case studies e.g. Umgeni Water: Case study to improve water quality using Data Magic.
- The % output from the tool is *absolutely* valuable.

Uptake and impact

- Budget must be allowed to continue with some activities such as workshops, etc. as this becomes a major aspect to address the 'elephant in the room' – marketing of the product, uptake of the product, testing and embedding of the product (with support from the WRC and research team / innovator).
- Thobe was doing her Masters at time of the project, now registered for PhD. An MSc and PhD would typically have a 5-10 year impact and uptake period.
- It was observed that stakeholders who should be using the WRC outputs/products, do not know who the WRC is and what they offer, e.g. the Green Drop. There is a significant gap between who create knowledge and who uses it. Increased marketing must be built into the indicators – with responsibility on 3 levels (to market): WRC, the research team, the stakeholder. A good example is the uptake and impact of the W_2RAP – it was embedded in regulation and repeat, repeat, repeat over almost 10 years until we have a risk-focussed mentality and planning approach in municipalities today.
- Project uptake is often driven by crises, with limited predictive influences.
- Academic elitism must be avoided, as value can be derived from projects not involving a world-class academia.
- RDI products should influence academic modules – e.g. data science and machine learning in case of the Data Magic project. Products such as software and tools should be availed to universities and become part of post-graduate studies (S&K). Students will benefit by having a framework and expertise but pushing themselves to master these (uncomfortable zone but necessary).

Reviews

- The Project Proposal Review by an External Expert could be restructured by keeping the old format and link in the new value categories.
- Researchers must be trained as part of annual WRC session/s.
- On Reference Group level, members may find value in knowing the indicators that will drive a project from Inception to Completion Phase. The review document should be shared with Ref Groups.
- Mid-project review becomes heavy on paperwork – consider a light-tough with 2 or 3 indicators to be decided during inception phase as part of U&I Plan.
- The Research Manager from WRC will not have the required info to do a review at Reflection Phase and will have to liaise with the Project Leader. This can be done by 1) getting info from PL, 2) call a meeting to confirm and clarify or 2) by working this phase into the U&IP.

Reports

- Feedback to the stakeholders via a short report and % score is important.
- Suggestion: % scores on RDI projects should aggregate and inform a system to rate WRC Research Managers, which again will be indicative of project performance and will push for progressive Inception Phase Indicators at start of project. This will also assist to encourage WRC Research Managers or Business Development & Innovation to improve their footwork in the industry to seek partners to transition from research to uptake in the industry.

Project 2: AMD new design/process

General

- First question that comes to mind from the introduction is 'is so-what?' What will be different? The WRC is already doing most of these steps...

Evaluation across phases

- The AMD project followed the suggested pathway to a large extent, although some steps were implied but not always expressed via the existing WRC project route. AMD stated its initial project aim, dealt with changes along the project pipeline, and then compared if the actual deliverable achieved the initial aims. If changes occurred, it was assessed if the project still achieved what it set out to achieve under changing circumstances. The set of indicators must configure flexibility to allow for changes or for adjusted aims. This could be in consultation with the Reference Group (standard practice) or with the BDI team.
- Project managers cannot commit to # research papers at Inception Phase – we propose a Yes/No baseline and turn this into a quantitative at later evaluations.
- The Green Steps are (mostly) already being done, with the exception of the Reflection Phase. However, the use of a metric will bring focus and new thinking by asking intensions and quantifying aims and intent.
- A longer Reflection Phase is supported, i.e. 5-7 years or longer. For example, in 1981 a patent was registered for biopolymer, uptake only took place in 2010's upon a push for biodegradable plastics. Uptake depends on spending capacity and available money. Similarly, a typical technology project takes up to 17 years to move from TRL 1 to TRL 9 stage.

Indicators

- One must be careful about predatory journals, one wants to measure quality, but need to keep in mind the fair principle of ''a good hearts law'' which would dictate if the WRC must embark on this road ONLY if it really will generate a realistic and fair outcome. It is difficult to choose indicators to support this ideal in light of the complexities evident in the industry.
- WRC already has processes in place to monitor progress and quality – although not as a metric. It is important to see what exactly these internal processes are and align accordingly. Also, Research Managers already plan on beneficiaries, who to communicate with, some indicators are already on the Reference Group agenda and Research Managers have a format to report back. These may not be well enough embedded though, otherwise why would the WRC commission this study?
- The green blocks (interventions) will strengthen the existing processes by embedding them and quantifying them. However, caution must be taken when using numerical targets where not realistic – e.g. citations, plan for publications – rather start with Yes/No and formalise the numbers later.
- Salami papers can be avoided by using the DoHET system to identify quality journals – this could be described in the indicator.
- A flow diagram would assist to differentiate between fundamental projects (practical) and ideal / 1st time projects – different indicators needed (or tool to be set up accordingly...).
- A new indicator is proposed that gives flexibility and ask "If... Then..."
- For all grey areas, Yes/No indicators must be allowed at Inception Phase to give opportunity for projects to shape and unfold.
- The indicator of peer-reviewed journals must be reworded to ''DoHET-accredited peer review'' – to ensure that only credible journals be referenced. DoHET screens out predatory journals, thereby adding to the quality knowledge output indicator.

- An indicator should be included that caters for projects that contribute to knowledge, although it not necessary allow for a quantifiable measurement such as # of publications. It is cautioned that the tool does not penalise such projects and find a way to give credit to their unique value offerings, albeit not quantifiable. Indicative scoring may be explored.
- Many projects (and institutions) do not lend themselves to U&I. For the AMD project, the business does not align with U&I but deals purely with research, development and innovation. This means that the research output is focussed on the business of the institution e.g. lecturing of students, with no focus on commercialised benefits. A relevant indicator would be a Technology Development Report, Concept Paper or Blue Print as artefact of knowledge – instead of (or in addition to) a commercial project.
- For the AMD project, the long-term value would have been: built of actual infrastructure, # honours students, # master student, # papers, # stakeholders activities, # conference papers, upscale potential from pilot to full scale.
- Value for money is hard to quantify. The rationale is that a relevant project, with wide application and knowledge dissemination would lead to value for money. A typical stakeholder may perceive a project with high relevance and high impact to present good value for money.
- The current WRC model measures demographics such as # black students, # HDI students, etc. This practice should continue. However, the WRC is delivering a whole lot more than just the initial demographics. Yet, the WRC is not counting the vast benefits to students without direct funding or benefit. In the academic environment, one WRC project most likely supports a range of other linkage projects or impact on higher numbers of students that benefit indirectly from a single WRC project. Amongst others, HDI students without bursaries could often benefit from a running cost WRC project, without having been listed on the initial demographics profile. This aspect is of great value as it targets a number of (indirect) student outputs and transformation and should be transferred into an indicator.
- From the AMD project, typical targets (indicators) would have been: 1) academic peer reviewed publications, 2) publications in W&S African and Mining Week (trade magazines), 3) WRC Policy Brief or WRC Technical Brief, 4) staged campaign of communications (2-3 per annum) on the topic (in association with similar topics where possible). Such further initiatives should be part of a longer-term U&I budget to be agreed on during the U&I phase.
- Indicators must allow for academic learning and translate into future projects.

Uptake and Impact

- Uptake is determined by need and crisis – experience has leant that uptake may take many years after a project close out or reflection. E.g. the Post Water Cost Model (WATCOST) product was not needed after 5 years but after 19 years when industry needs dictated it.
- From a student perspective, WRC is doing very well to build capacity and support career advancement for students. NRF uses metrics that rate university professors and lecturers, but do not consider (support) students. WRC is funding projects and students which open significant opportunities.
- At U&I phase, it is advisable to call industry partners in the very beginning of a project in ensuring an active partnership and possible uptake of the RDI output into the market space.
- Uptake cannot be ensured or predicted, as there are too many unseen barriers. For AMD, appropriate steps would be to include industrial partners and have inclusive workshops to explore value. Appropriate audiences should be identified, appropriate knowledge shared, and knowledge need to be verbalised. Dr Sheridan is from industry and moved into academia – this is a crucial element of knowledge share and potential uptake.
- There is value in repetition and targeting different audiences, e.g. regulator, public, policy makers. A mechanism for repetition is required to find a way to reach these audiences and repeat messages of value. The notion is that repetition finds impact only after a few events,

which contradicts the WRC means of having 1 or 2 workshops or conferences, then discontinue knowledge dissemination.

- Uptake is NOT determined by the market or by need, but rather influenced by crises, political and economic environment.
- Retrospectively, uptake of the AMD would have been advanced by: 1) informing EPCs (Golder, SRK, etc.), 2) add the technology to Portfolio of Techniques, 3) communicate extensively to mining houses and tell peers what has been achieved, 4) involve regulatory and industry bodes such as mining, environmental affairs, water and sanitation and find a best-fit to working principles such as EIA, 5) target Research Communities and R&D centres to illustrate that the proof of concept is practical and has successfully been applied.
- The WRC is ideally placed as honest broker and influencer in the sector – it has no agenda, host of new knowledge, and is independent. WRC should take a more pertinent role and responsibility to influence government and policy, and to bring role players together to ensure uptake and impact.
- More leveraging should be done, e.g. Rx WRC money should leverage Rx co-funding. This will improve the likelihood of uptake. A partnership approach and upfront buy-in is essential.

Reviews

- Many of the steps proposed are already part of the WRC project cycle, e.g. stakeholders and deliverables and targets are standard items on the Reference Group Agenda. The proposed indicators could be a mechanism to further embed them.
- The WRC has a guideline for internal review, which will be helpful to inform a decision to restructure Project Proposal Reviews and align suggestions with existing formats.
- Projects differ and all indicators will not be relevant – the tool must allow to ignore or rule out irrelevant indicators and only measure those agreed and selected. This aspect will alleviate the current practice and format of the WRC proposal template where researchers feel obliged to write ''something'' against all impact areas (social, environmental, etc.) instead of just exploring the 1 or 2 of relevance. Descriptive notes may be needed in the tool, to guide the user.
- The Project Review templates must be left as-is as no benefit from recategorising the review template.
- Measurement is already built into the WRC system and can easily be adjusted to incorporate the metric. WRC has a massive database (BMS) with a wide reach to people and organisations. Automatic triggers can be configured to collect information during Reflection Phase or to support repetitive events after project completion. Reporting to the Dept. of Higher Education must be explored.
- Timeframes must be staged practically. From a student perspective, 12 months would allow for under-graduates and submission of a post-graduate thesis plus commence of examination, publications would be in draft, conference papers would be possible. Five years would allow to check conformance against the DoHET report (January each year), graduates and publication confirmations.
- Completion- and Reflection Phase information should be readily available from the student supervisor, Project Manager or through the university.
- A mid-term review must at best be light-touch and will serve best value if it assists to redesign the trajectory of the project and prepare for completion review.

Reports

- Report-back to stakeholders may take a 2-pager document: P1 – statistics from the metric to report on students, journals, potable water in taps, expenditure (R1m delivered: XYZ). P2 –

actual story about a student from where, what did she do, impact of the project, savings, career story.
- Feedback reports will strengthen the position of WRC as a necessary and valuable player in the sector by generating impact, promote stability and security in organisations, via training of more students, generate more knowledge, and create/mobilise expertise.
- Project completion should have the benefit of a full set of results, at time of the WRC Technical Close-Out Report. Some indicators may not have been realised and flexibility should be built into the tool not to penalise this, if valid. Only at this stage would it be possible to plan forward – what happens next. For AMD, close out determined what happened afterwards, not possible to predict this in advance.

Project 3: Agro-forestry guideline

Evaluation across phases

- The Reflection Phase is an excellent idea and best addition to the measurement of output. But the Project Manager will not have this info 5 years later. Students move and no tracking is done on how students are practicing agro-forestry.
- WRC is commended for focussing on project level measures, given the scarcity of funds, 20% budget cuts – this process will give WRC leverage to motivate for new projects/budgets against a report of achievements supported by the metrics.
-

Indicators

- Institutional level indicators are difficult to define and measure – it makes more sense on project level.
- Care must be taken with novel work, as there are many curveballs that could influence project targets. One needs to build in safeguards in the tool when targets need to be reviewed.
- Indicators should not be related to ''uptake'' but to ''opportunity to create uptake''. Create indicator for ''Create opportunity for uptake Yes/No'' (see explanation below).
- More indicators are needed to get product or knowledge to the general public and raise awareness. For the agro project, information is shared at a farmer's day or workshop, but implementation required funding and time, this is a long process and need M&E to confirm uptake and impact. A participatory research approach is advised for agro-type projects.
- Commitments (indicators) for agro projects would be: students, qualifications, workshops. If more resources available, Research Manager would have extended the farmer's days and experimentation to implementing ideas in the field at community level.
- The Project Leader argued that all steps are done anyway... what is different apart from the metric?
- Value for money is complex to measure and not recommended. If a project has commercial intent, one could perhaps measure financial benefit, but this will not be possible for the agro project. Economic benefit analysis and cost benefit analysis are complex and should not be included in the metric.
- Question should differentiate between marketing the ''value'' or the ''output''.
- Agro project – there is a distinct difference between R&D and Research for Development, with the agro project falling in latter category.
- People like numbers in a metric, as it is useful when budgeting for students, conferences, etc. however, the metric must produce a realistic value.

Uptake and Impact

- Setting of targets against indicators does not guarantee or lead to uptake.
- Commercialisation of products does not equal upscaling of practice in the field. Agro-forestry may become a practice, but it does not mean that market penetration is achieved – example: how many people is taking up rainwater harvesting.
- WRC should ring-fence and fund M&E, this is the true indicator of uptake and implementation. Uptake and impact should be reviewed after 5 years or longer – no project achieves uptake at project completion – move the green block forward as U&I is not achievable at this early stage.
- Researchers are good at knowledge creation, solve problems via academic work, conceptual thinkers, etc., however, they are not necessary expert at communication or implementation of concepts. It may be necessary to take a concept developed to a person with skills to communicate, implement and monitor & evaluate (M&E).
- In the case of agro projects, the ARC has multi-disciplinary researchers who may have the skill to develop academically and implement on the ground, but this is rare and requires a different resource set.
- In principle, it is supported to set out numbers or qualitative targets to increase awareness and influence thinking of researchers, however, U&I must be removed as this should not determine the success of a project or research team.
- WRC must take responsibility for taking concepts/products to next level (=uptake). M&E is not the job of the Project Manager, it must be ring-fenced in WRC, have budget, independently done, stand-alone activity, is not needed for all projects just for suite of projects that has uptake relevance or opportunity. Example: TIA hired a specialist company for M&E.
- Uptake and impact must be evaluated in the long term, and unless otherwise agreed and resources should not be the responsibility of the research team.
- Example: DSI realised funding projects does not convert to uptake, therefore TIA was created – which is a good idea, but failed... It is important not to create unnecessary new structures, rather keep simple and strengthen existing structures.
- WRC is good at workshops, research and discussions on impact on policy, etc. This element should rather be strengthened, and value of repetition exercised (and funded). WRC should: build in-house capacity to M&E and execute in-house.
- U&I should not be built into the metric – it requires specific skills and budgets. If U&I is to be facilitated, the following is needed: allow extension to project, with funding. WRC needs to decide what funding will lead to uptake.
- U&I is needed, but to be done by WRC and much later, not at completion phase.
- U&I cannot be used as measure of success of a project for projects such as agro-forestry.

Reference Group's role

- The Project Leader is concerned about how the success of a project is measured from Inception Phase. The Reference Group is not part of process and setting of targets is critical to the success of project. One risk could be that success is measured against incorrect benchmarks or targets are set too low or too ambitious. When targets reach the Reference Group, the contract is already signed and it's too late for the Reference Group to influence the targets. For the Agro-forestry project, targets were set too high, but PL managed to achieve them.
- An alternative view is that the Reference Group's role is to guide and provide subject expertise, whereas the role of planning team is to set targets.
- Metrics are of value to the Reference Group as it will strengthen their role and allow them to flag concerns early on. Will depend on the quality and diligence of the Ref Group members.

Reviews

- The replacement of the existing external review with core value categories is not supported, the current system works well and is well understood. External reviewers are volunteers and will not appreciate complex indictor-driven systems. It is recommended to add Capacity Building.
- Do not include a mid-project review, no value. Most value is in the review at Reflection Phase.
- PLs will not have information to complete Reflection Phase review, as the project lead or students will be gone and information lost. It takes time and money to keep track, not worth it – WRC projects are already stretched by expecting a lot against low project budgets.

Reports

- The value of the Framework and metric is not applicable to the stakeholder, more valuable to the WRC. The team do not agree that the stakeholder should receive a report. Stakeholders are too diverse group. WRC is only responsible to its funders and investors. WRC reports to the portfolio committee as being accountable for taxpayers' money. For example, agricultural sector pays a research levy for agro-RDI. Stakeholders may have opinions and interest, but they are not investors. Note: refrain from using term stakeholders.

Project 4: Responsive pipes – new technology/design

Evaluation across phases

- The team can see the value of the suggested Framework over pipeline project lifespan. The team liked the quantification (measured) output from metric.
- The suggested Framework will add value to stakeholders and WRC. Will also force Reference Group members to be more active, especially during Reflection Phase.
- Evaluation of the data in the metric is interesting from student perspective and the team can see how value can be derived from planning to Reflection Phase.
- Usefulness of metric and how project performed at end of cycles: yes definitely.

Indicators

- Allow for adjustment against indicators when circumstances require. Be careful not to set benchmarks too low.
- A suite of indicators will assist to contain scope creeping and prevent Ref Group to add on to project scopes.
- The initial take was that 60 indicators are too much, however, in context of the PowerPoint presentation, it can be seen that many indicators will be eliminated and not used to penalise the research team. For pipeline project, e.g. from 60 indicators only 20-30 may be selected.
- Citation's indicator must start with Yes/No, expect 0 by completion, expect higher number by Reflection Phase, expect very high number in 10-20 years. WRC must plan to pick these up after 10-20 years.
- The pipeline projects revolved around the use of fibre optic cables as means to detect leaks for cold water leaking into the ground. 2nd project improved on 1st by allowing for detection over long pipeline stretches (typical bulk lines). The 1st project focussed on discreet measurement at 20 positions, if longer lines, measurement is compromised. The 2nd project allows for distributed measurement continuously still using fibre. The output and indicators would have been: method to monitor; students; publications; patent; conference papers; international liaison. Patents were not planned.

- The Green Steps would have been delayed by two events in the case of the pipeline study: 1) two devices had to be returned to Germany because they malfunctioned; 2) Covid – international collaborators on vibration detection could not visit SA. This would have prompted a review of the ''international collaboration'' indicator.
- A successful project such as the pipeline project – with positive metrics – is marked by a student who gained skills on 1) interpretation of raw data 2) deeper way of thinking and approaching a problem 3) got exposure to the world of RDI 4) got design and research experience under promoter such as Prof SW 5) got paid – becoming financially independent from parents.
- Value for money: R800k project cost, offset at R20-30/m^3 with 30% water lost in SA – this would imply a huge financial benefit and cost benefit ratio, in other words exceptional value for money from the pipeline project. One will never be able to move away from notion to measure value for money. This project would have been able to calculate cost-benefit and RoI – but this was not part of the follow up studies.
- For the pipeline project, targets were planned from inception: papers, articles, students and info would have been available at Completion and Reflection Phase from both the Project Leader and the student.
- The project would have been able to report against indicators in each phase: No for patents, licenses, publications in journals. Yes, for articles in magazines, undergraduate students and master students, spinoff projects and career advancement.

Uptake and Impact

- Potential uptake at Water Boards, not municipalities – none of the Water Boards were interested to fund 2nd project. R1.2m – WRC funded the study with support of the University of Pretoria's Dean of Engineering.
- WRC is best placed to introduce these projects to Water Boards. The Project Leader is above all a researcher, not an entrepreneur – many high potential outputs or spinoff projects get lost as it does not find its place in the marketplace.
- The research output is the primary interest and role of the researcher, and further work needs to be done to ensure uptake and impact. U&I would be brought about by implementation on a sizable scale with dedicated contractors. Three possible ways: 1) patent owned by UP (Enterprises University of Pretoria) to set up business for leak detection and sell business with PL getting royalties; 2) outside party buy rights and bring to market; 3) buy-in by Water Boards, but this would need WRC to facilitate; 4) (TIA not known). WRC is better geared and commercially astute to do this as opposed to a university environment.

Reviews

- Proposal Review: It is suggested to combine the existing six with the suggested seven – it will also give the Project Leader more guidance on what the reviewer will consider, and to plan accordingly. It will strengthen the existing system.
- Mid-review: Yes and No. Yes, for some of the indicators not all, but not for all projects. No for sticking to the existing review process at Reference Group level, not using metrics.
- Reflection after 5 years – 3 years too soon. Duration of 2 years for Masters on this type of project.

Reports

- Feedback to stakeholder is supported – Johannesburg Water being a case example.

Project 5: Buffer Zone guidelines

General

- The BZ project considered multiple projects. Additional funding was secured at project completion phase, advanced science was explored, stakeholders were part of the process, and training was conducted. The key reason, however, why the project was successful, was because of its inclusion in national legislation as a guideline. An MSc student graduated from this project at UKZN and is working at SANBI in the freshwater/wetland environment.

Evaluation across phases

- All interviewees responded ''yes'', the Completion and Review Phases are valuable. It will improve the way that the WRC reports on projects and communication with their stakeholders. The Reflection Phase is seen as valuable and that it would be a fair ask from Project Leaders to provide the information.

Indicators

- In terms of training, a value indicator should be accredited or CPD earning training whereby the research team could partner with WISA, SAICE, ECSA. This will ensure that the research output reach wider than just the immediate WRC knowledge dissemination initiatives, and possible be a revenue stream to continue knowledge distribution and application => improve uptake.
- Value for money – no specific comment, it remains a difficult subject and aspect to 'measure'.
- Students/YWP on WRC projects benefit from exposure of the student to the work, field and people – this can be measured qualitatively. Such opportunities are limited at universities and the WRC is doing a sterling job. An indicator should be added re mentorship of interns / students.
- Spin off projects, training after completion, and extended projects should be value indicators. This must be allowed for in a changed Scope of Work.
- The key mechanism to be addressed to improve uptake and impact is marketing – this must be a key indicator.

Uptake and Impact

- Lessons learnt was that, after 2nd phase, uptake was still not optimal. A mechanism needs to be in place to continue with conference papers, training and support AFTER project completion. Budgets need to be in place to ensure continued activities in support of increased awareness and uptake.
- Ideally, the RDI output will find a suitable partner which then transition it from a WRC project to a partner project. This can happen in two ways 1) by identifying such a partner/stakeholder at concept phase, someone with interest and need to get the product to the end-user, and 2) to keep on sharing information after project close out until such a partner takes interest and ownership. *Ongoing support is crucial to increased uptake.*
- Another mechanism is for a suite of tools to be developed and marketed to the sector to drive uptake and to increase value.
- From DWS perspective, the key success factor in the BZ project was the alignment with the Water Use License (WUL) protocol and providing a tool to meet a specific sector need. The need was to have standardised process and method to apply in WUL. The enablers were the **close cooperation with the legal team in DWS which gave weight to the guideline as reference in legislation, as well as the piloting (implementation) of the tool and training in the field.**

- One mechanism is to identify RDI products that respond to DWS needs and for DWS to be a co-funder to critical projects. The WRC CEO would have to approach the DWS DG to discuss a special budget for RDI projects that would be of direct value to DWS, which will again translate into value to the end-user (benefit: social, environment, economy, etc.).
- The Green Steps will assist uptake but is to a large extent already in place in WRC. The proposed Framework add value by placing metrics / measurement on the planned outputs.
- The BZ project put measures in place for uptake, e.g. journal articles. The WRC created a space to negotiate and to look beyond the 1st phase of the project. One risk was to set too ambitious targets which could not be achieved; hence, some flexibility is needed (I). A Project Manager does not always know at the start of the project what the outputs will be, some qualitative baseline is recommended until the project mature.
- From DWS perspective, the BZ project involved a lot of stakeholders, especially given the pre-set goal that the guideline would be referenced in legislation and will impact on policy. The tool was meant to serve a suite of sectors in aquatic resources, i.e. mining, urban, subsistence, agriculture, municipal.
- Experience with INR, UKZN and UFS indicated the potential to put out a research product/tool into the university environment as lever to capacitate more students, however, this will require co- or counter funding. Some flexibility must be built into the metric to identify such ''potential' and then develop it, ideally with WRC in the role of co-funder and knowledge broker.
- From a student perspective, both scenarios were evident in the BZ project. An internal student at INR participated and benefited from the BZ study, but internal funding and assessment was the mainstream project.
- For the BZ project, articles were useful. The key limitation was the time to share the final reports. BZ required a supporting portal to share spatial data to users to enable use of the product. One mechanism would be to set up a website to share data or some platform to give users access to data generated under specific projects.
- Another mechanism is conferences to keep the momentum going and to ensure uptake of the product. Users/stakeholders need to be REMINDED of the knowledge outputs – this must be done via consistent presence at conferences and ongoing training.

Reviews

- Project timelines would depend on the type of project, but any changes in the SOP would not impact much on existing planning times. The student is the project, and the benefits to the student was indirect, and would not have been part of the initial set of indicators. Thus proposed/existing timelines are seen to be realistic, although flexibility should be retained to allow for project to unfold further.
- The Review Phases will add value to realign and be more explicit. Care must be taken not to make the process to onerous.

Reports

- Reporting back to stakeholders should include all indicators, but be adaptable and flexible to allow for projects which encountered unplanned influences, or projects that produced unplanned or undesirable results (but still of value), etc. Achieved, exceeded, etc. status is valuable and holds WRC and project teams accountable.
- Mid-review could be useful in terms of building in flexibility at this stage.
- Although, flexibility should be built into all phases. An opposing view is that mid-term review is already build into the existing WRC cycle as it happens informally when meeting with the Reference Group. Mid-term reviews could be considered for 5 years projects, but short terms projects already have a form of informal reviewing.

- The student perspective confirms that the indicator information will be available at Completion and Reflection Phase, depending on where the student is within her study period: 3 years will be able to report on graduation, but >5 years on career advancement. The 3-dimensional score is important and may warrant an overlap. Example: Collaboration, quality and networking & learning imply Effect; Solutions falls in same category but can be kept apart before collapsing in 3; elements of collaboration, quality, network and learning, capacity building and uptake and impact group well together.

Project 6: Biochar technology – method

General

- It is commendable to see that WRC plan to put indicators in place to measure and quantify the impact and success of a WRC RDI project. It will hold Project Leaders and WRC accountable and will steer research in the right direction.

Evaluation across phases

- The Completion Phase is crucial as the WRC and researchers need to reshape their thinking as to what is envisioned and delivered at the end of a project, and how it will unfold to fulfil the research potential.
- The TOR must be reconfigured to allow a Project Manager to think bigger and broader than just the research output, and to explore wider partnerships.
- The Completion Phase is supported as it holds both the Project Leader and the WRC accountable – to measure if the plan has been delivered upon and to leverage WRC resources, stakeholders and connection to transition research products into the market/user space.
- The Reflection Phase allows for changes to be accommodated, e.g. (unplanned) under-graduates and PhD student that emerged from the Biochar project.
- In summary, the Green Steps would have added value to the Biochar project by:
    - Step 1 (Proposal and Review) is inadvertently done already but giving Step 1 structure will allow deeper planning/thinking on the project uptake and how it will be measured for value (success). It will also ensure that commitments are made upfront by partners and that WRC uses its leverage and networks to draw in parties with interest
    - Step 2 (Inception) would have made for a stronger project with more realistic timelines, budget, risk identification, and selection of transition partners
    - Step 3 (Completion) would have confirmed that the project exceeded its expectations
    - Step 4 (Reflection) could have accounted for the unfolded potential of number of undergraduates and PhD student that emerged from the project (3-5 years review is supported).

Indicators

- The project profile during Inception Phase must add a new category for 'partnerships. This is not to be confused with 'stakeholders' as its intention should be to identify, approach and include relevant partners right at concept of the project, and to ensure transition from research into commerce and uptake of the research product. In light of the Biochar project, the partner should focus on private sector partners specifically, who has an interest and ability to upscale the research product. In the case of Biochar, 3 co-funders were involved, each with a specific role and expectation of value.
- The Inception Phase should be broadened to include an indicator that speaks to the opportunity to find a co-funder/partner with vested interest in the product. WRC is excellent

at doing research, but need to draw in partners with the interest, money and ability to take ownership and advance uptake in the market. As example, municipalities should be partners on biochar as they are directly involved in end-use and beneficiation to the end user. eThekwini, Johannesburg and Cape Town would be ideal to advance this technology as they have already progressed in terms of resource recovery and re-use.

- The Biochar project did not have expectations (indicators) at Inception Phase, except a possible publication. The opportunities unfolded later on during this 6-month project. In retrospect, the indicators should have been: PhD student emerged from this project; pilot project unfolded to have high commercial potential; women with basic education and no income were trained and earned income.
- An indicator must be included to provide for 'the opportunity to be commercialised', based on the question "is this research that can possibly result in commercialisation?" The metric and Framework should emphasize on where the project will ultimately lead and to find a partner at inception phase that will benefit from the product.
- This will serve as mechanism to transition from pure research to uptake to service delivery.
- The Biochar project was a mix of social and engineering aspects and unfolded over the project lifecycle. Should an inception phase and SMART indicators have been introduced, it would have ''forced'' the team to think about uptake and the potential of the project and put measures early on in place to ensure uptake if the research product warranted such investment. The key benefits (value) to the end-user would be 1) recovery of a wasted resource (faecal sludge), 2) skills of women, 3) alternative income stream. The value to the partner would be 1) income generation of low-tech, 2) fulfilling service delivery mandate.
- Problems are likely to arise that impact on project delivery and its agreed indicators, e.g. the Biochar project faced risks 1) women took longer than planned to train, 2) substrate quality differed, 3) biochar design did not meet expectations. These risks were mitigation by way of appointing a technical person for oversight on training and implementation, recourse in method was taken to focus on colour of smoke (gasification) instead of relying on temperature and time which resulted in lesser ash and higher char conversion. Flexibility must be built into the project lifecycle to allow for changes, without relaxing accountability.
- Value for Money as an indicator is hard to define or measure. It is suggested that WRC ask questions of which the answers cannot be defended, thereby devaluing the question. It is suggested that the question be changed in the TOR, project proposal phase, and indicator list – *''What does the WRC want to see for spending this money/investment?"* and *"What does the Project Manager offer for the budget?"* For the Biochar project, the researcher can plan and respond: *"For R1,5m, the following value for money is proposed/achieved",* which again gives WRC a tool to compare different project proposals in terms of their value offering per budget amount. For Biochar, a quantitative value for money assessment would not be possible, and an economic assessment would not be practical (for all projects).

Uptake and Impact

- A U&I step is supported, as it will allow inclusion of partners from the start, who then would commit funding for research outputs (should the product/pilot be successful).
- The sustainability of a project is tied to having an active partnership, to grow and take ownership from start of project to exit from the research phase of the project.
- Yes – to all questions pertaining to measuring progress and impact, with emphasis on holding all (project managers, research teams, WRC, partners and stakeholders) accountable to their roles and commitments and targets.

Reviews

- Tracking is supported in all its proposed forms – as it equals accountability.

- The existing External Review criteria is not considered optimal as it's subjective and does not guide the reviewer in terms of specific measurables and rating, thus rendering the review subjective and arbitrary. High value is found in ''Relevance'' and "Scientific Soundness" and these should be retained. WRC could then consider collapsing the 7 core value categories with these 2 existing review categories. This will allow a direct link between relevance, quality and collaboration which again will translate into commercialisation. An example was given re the Manufacturing Circle that pulled different resources through networks to respond to a health need (Covid) through collaboration that matched relevance.
- A mid-term review is essential as it provides a mechanism to change recourse if needed. The workplan must plan for such mid-term reviews and agree on the indicators to be used. WRC leaves this aspect to the end of a project by which time mitigation is "after-the-fact".
- Caution must be given to WRC's expectations and pressure to show a ''successful, good project'' that ticks all the indicator boxes. Unexpected / unplanned / bad results are often also meaningful and important to shape future technology, research and innovations. E.g. Biochar did not succeed in meeting technical parameters and ash was overshot by 80%. These ''failures'' were useful, as it informs future Biochar projects in terms of training needs, more trails, and quality checks on import product.
- Noting this caution, one must not be tempted to tweak indicators, as their initial scoping and the recourse taken must be reflect on the practicalities of the project.

Reports

- Caution should also be taken on what and how to feedback to stakeholders. They expect to see a ''successful projects'' as defined by high scores against a set of indicators. If a project does not succeed, for whatever reason, but still generates value and new knowledge, such reporting should carry sufficient depth and discretion. The metric tool must carry sufficient intelligence to distinguish such cases.