

**DEVELOPMENT OF A METHODOLOGY TO ASSESS
KNOWLEDGE UPTAKE BY TECHNICAL PROFESSIONALS
AND DECISION-MAKERS FOR DEVELOPMENTAL
WATER SERVICES**

MB van Ryneveld • SL Sproule

WRC Report No. 1519/1/07



Water Research Commission



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FOR DEVELOPMENTAL WATER SERVICES**

Report to the
WATER RESEARCH COMMISSION

by

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and
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EXECUTIVE SUMMARY

i. *Background and motivation for conducting the research*

Over the past decade or so in South Africa, there has been a fundamental change in the way in which services are provided, from an approach dominated by technical factors to one in which a range of factors other than purely technical factors are addressed. In this new approach, services are provided to meet developmental objectives, with an emphasis on poor communities. In the water field, a suggested term for this new approach is 'developmental water services'. This change has been acknowledged by the Water Research Commission (WRC) in its own knowledge review, where it observed that "...the sector is in transformation", pointing to a "shift in paradigm" as the challenges of integrating technical factors with other factors such as business aspects become more established (WRC, 2002: p.24, 31-32). The review went on to indicate that this is a relatively new field (specifically referring to Integrated Urban Water Management) and that human capacity is relatively low. The Development Bank of Southern Africa (DBSA) also identified the low human capacity in the sector and indicated that it intended "...to establish a knowledge institution [in the following] year with the aim of unlocking capacity of local municipalities" (Phasiwe, 2003). However, experience with students in several formal tertiary level courses and experience with practitioners in the field suggest that while there is fairly significant knowledge available within the research community on the change 'from technical design to developmental service provision', there appears to be insufficient uptake of this knowledge by technical professionals and decision-makers responsible for service provision (Van Ryneveld and McCutcheon, 1997). **Knowledge uptake** is defined here as 'the active acquisition of disseminated information, the comprehension of the information and the ability of practitioners to apply the information in the field'. Significant attention in recent years has been paid to the development of new organisational arrangements, policies, legislation and procedures for developmental water services. This exploratory study, by contrast, turns the attention to the uptake of knowledge by individual practitioners at the higher levels within the new service provision paradigm.

ii. *Study aims*

The study aims were:

- (a) To *review the literature* on the topics of (i) developmental water services provision; and (ii) knowledge uptake and related factors, both individually and in combination.
- (b) To develop a *methodology* to identify how the uptake of knowledge by technical professionals and decision-makers in developmental service provision in the water sector is taking place in practice.
- (c) To make an *initial assessment* of how knowledge uptake (as described above) is in fact taking place in practice, and to propose *strategies to improve this*.

The core question of the study was stated as follows: "Assuming that there is good information available and accessible on the topic of developmental water services, why are individual practitioners at the higher levels not acquiring, comprehending and applying that knowledge better, as evidenced by persistent service delivery backlogs and poor sustainability?"

The question really has three parts to it:

- (a) Is there (as assumed) good information available and accessible on the topic of developmental water services?

- (b) If so, is there a mismatch between knowledge available in the literature and knowledge taken up by individuals?
- (c) And if there is a mismatch, why is the knowledge available in the literature not better taken up by individuals?

A key objective of the study was to understand better what the problems were confronting individual technical professionals and decision-makers, and to make connections - if there were any to be made - between the problem in the *global* sense (of the sector having made good progress in terms of policy etc., but having performed less well in terms of delivery and sustainability) and the specifics of the problems confronting *individuals*.

iii. *Brief summary of the major results and conclusions*

Methodology to investigate knowledge uptake and context:

The investigation focused on the individual, and explored the uptake - meaning the acquisition, comprehension and application in context - of knowledge on developmental water services.

The sequence in which these components were explored was as follows:

- (a) The investigation started with a literature review of *knowledge/information* on developmental water services.
- (b) This was followed by a literature review of knowledge uptake by the *individual*.
- (c) However, in investigating the *individual*, it was found that one could not make sense of the required characteristics of the individual without also investigating the *context* in which the individual was operating.
- (d) Investigation of the individual and context in turn led back to a re-examination of the *knowledge* - raising questions as to whether it was appropriate to the *context* (and to the *individual*).

Within the study, *knowledge* and *context* are addressed under the heading of developmental water services. *Individual* characteristics are addressed under the heading of competencies.

One does not (and cannot really) measure directly what knowledge is taken up by an individual in the sense of what is acquired and comprehended by the brain; nor is it particularly important. Rather, as evidence that knowledge has been taken up, one measures what the individual can *do* with that knowledge. Knowledge uptake is therefore demonstrated through competence. Knowledge must be visible and used in practice for it to be considered taken up by an individual. Consequently, knowledge uptake is best explored by considering those competencies that are observable in the decisions, discussions and actions of technical professionals and decision-makers. The *methodology* which has been developed in this study, which made significant use of in-depth case studies in the form of interviews and interactions with individual practitioners, is one which enables those observations to be made.

A key finding of the study is that for effective provision of water services within a developmental context, there is a close interrelationship between the three components of:

- (a) knowledge/information (on developmental water services);
- (b) context; and
- (c) individual;

...and that it is difficult to address any one of the three components without reference to the other two.

Context in developmental water services:

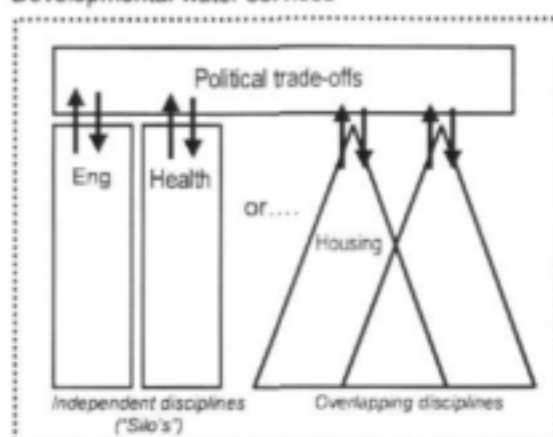
There *is* a lot of information readily available in the sector on the provision of water services to meet developmental objectives. This information emphasises poor communities in which a range of factors other than purely technical factors are addressed. What appears to be weak or missing

is information on how to apply this information in context; and that context is the bureaucracy consisting of a combination of political and technical disciplines.

Developmental water services was defined as 'the provision of water services to meet developmental objectives, with an emphasis on poor communities, in which a range of factors other than purely technical factors are addressed'. A key finding of the study was the identification of a further major aspect of developmental water services as 'a combination of political and technical disciplines in a unified approach, consisting of:

- (a) Implementation of services on the ground carried out by technical professionals (in different fields such as engineering, health, housing etc., often arranged institutionally into departments along those lines);
 - (b) decisions, trade-offs and resource allocations (within limited resources, to meet developmental objectives) carried out by politicians;
- ...and the institutionalisation of this, or translation into the bureaucracy'.

Developmental water services



As to whether there is literature on these newly identified contextual aspects of developmental water services, the answer is that there is some literature on individual elements, such as:

- (a) trade-offs;
- (b) different disciplines (particularly political and technical/engineering);
- (c) different disciplines asking different types of question;
- (d) formalisation of arrangements in the workings of the bureaucracy;

...but that it is more dispersed and limited than the technical literature, and is therefore not readily available and accessible to the water services community.

The in-depth interviews overwhelmingly supported the notion that developmental water services is 'a combination of political and technical disciplines in a unified approach, and the translation of this into the bureaucracy' (as described above). From the comments by interviewees on the context within which they operate, a *simple preliminary framework* was constructed to describe the key elements and characteristics of the workings of the bureaucracy as it applied to developmental water services. This framework consisted of two main *categories*, with a third category applying generally to both of them, and a number of sub-themes within each category:

- (a) *Interactions between politicians and officials/technical professionals - nominally 'down the hierarchy' from politicians to officials - involve:* (i) translation or conversion from: policyto delivery, generalto specific, abstractto concrete, purposeto technique, and non-technical.... to technical; (ii) the bureaucratic aspect of this translation, namely delegation of authority (and reporting in reverse), and allocation of resources, specifically budget allocations (and reporting on budget expenditure in

reverse).

- (b) *The making of trade-offs and key decisions of principle, requiring prioritisation between different projects and different departments - nominally 'across the hierarchy' - involves:* (i) conflicting objectives, (ii) trade-offs and prioritisation within limited resources, (iii) risk and mitigation of risk.
- (c) *General characteristics* applying to both of the above involve: (i) Communication, including communication across all interfaces and between all parties; courage/boldness in communicating the consequences of difficult choices; (ii) a team approach, and understanding the whole system, including trust and mutual support of different players, competence of different players; and (iii) the translation of these matters into the working of the bureaucracy, including: exercise of authority and fear of transgressing authority, slowness to get an interview or decision.

This framework - together with the supporting evidence from the in-depth interviews - is a key output of the study, providing a preliminary description of the *contextual* elements and characteristics of developmental water services.

Two other key observations were made in respect of the context:

- (a) The *interfaces* between different groupings and disciplines (e.g. politicians, technical professionals, community) - and *communication across these interfaces* - are also identified as being critical.
- (b) The major conclusion from observing institutional arrangements and decision-making processes is the *critical importance of the Mayoral Committee/Executive Mayor* in decision-making for developmental water services.

In summary, it was the *contextual* aspects of developmental water services, consisting of 'a combination of political and technical disciplines in a unified approach, and the translation of this into the bureaucracy' which on the evidence of the in-depth interviews would appear to constitute the major challenge facing high-level technical professionals and decision-makers in the provision and sustainability of water services.

Competencies as evidence of knowledge uptake:

A framework of competencies for the developmental water services sector as a whole (including technical professionals and decision-makers), drawn from both the literature and the interviews, was constructed and is set out in Table 1 (see p vii). What is suggested is that individuals emanating from different disciplines may be stronger or weaker in particular competency areas, but that the full range of competencies should be covered by the sector as a whole. In most cases, the interviews supported, enhanced or confirmed the evidence in the literature. In some cases participants in the study stressed issues not identified in the literature.

The competencies were classified as *methodical competencies* and *social competencies* or *competencies of personage*. Methodical competence (MC; Table 1: section 1) involves learned competence in the discipline or field. Social competence and competence of personage (SCCP; Table 1: section 2) involves the capacity to work with various stakeholders in the context of work and personal attributes that are necessary to more (or most) effectively complete the work at hand. Both Methodical competence (MC) and Social competence and competence of personage (SCCP) are underpinned by Judgement (Table 1: section 3).

TABLE 1:
COMPETENCIES FOR TECHNICAL PROFESSIONALS AND DECISION-MAKERS

Methodical competence (1)

Academic (1.1)	Practical (1.2)
Active life-long learning (1.1.1) - accessing information - lifelong professional development - initiative to continue learning	Technical know-how and skills (1.2.1) - scientific method and analysis - knowledge of contemporary issues - materials and design knowledge
Knowledgeable analysis (1.1.2) - compare information or situations - interpret & analyse, recognising the relevance of, given information - evaluate the viability of solutions - plan provision of services	Numeracy (1.2.2) - understand technical information and the basic structures of an engineered system - perform basic calculations - interpret diagrammatic information (e.g. graphs) - visualise plans & product
Technical decision-making and problem solving (1.1.3) - analyse new situations - integrate and apply diverse fields of knowledge in practice - overcome obstacles - revise processes	Information (ICT) Skills (1.2.3) - software applications - macro writing - design tools - seek, store & retrieve info as needed

Social competence and competence of personage (2)

Administrative (2.1)	Intrapersonal (2.2)	Interpersonal (2.3)
Business sense (2.1.1) - understand business processes - estimate economic costs - project management - knowledge of legislation and public policy	Listening (2.2.1) - listen to others - synthesise different perspectives - observe interactions	Teamwork (2.3.1) - respect for others - productive working relationships - function on multi-disciplinary teams
Environmental awareness (2.1.2)	Creativity / Innovation (2.2.2) - original & alternative solutions - show initiative	People management and leadership (2.3.2)
Ethical (2.1.3) - show integrity - belong to professional societies - responsible to the profession - confidentiality	Adaptable (2.2.3) - anticipate and predict change - manage change - help others adapt	Working with stakeholders (2.3.3) - client focus - understand needs of clients - negotiation - work within socio-economic context
Time management (2.1.4) - establish time frames - maintain timelines - meet deadlines	Awareness of self in context (2.2.4) - motivation - designated responsibility - multiple demands - aware of potential problems	Communication (2.3.4) - language proficiency - AV presentations - comprehension and writing - oral communication - interpersonal communication

Judgement (3)

Judgement - Judgement is fundamental to methodological, social and personal competence and impacts in every decision and sphere of influence of the individual - Judgement includes the ability to evaluate information, isolate central issues in decisions, balance competing interests and check viability of decisions

The following issues were identified as being key:

Decision-making, that requires the ability to understand, interpret or analyse technical or mathematical information, in the provision of water services requires (amongst others) three levels of methodical competence (Table 1: section 1), namely:

- (a) *numeracy* (involving the ability to interpret graphical information, perform basic calculations, visualise the product of drawn plans, and some basic knowledge of engineered systems) (Table 1: section 1.2.2);
- (b) *knowledgeable analysis* (involving the ability to not just understand, but interpret and analyse information and use the information in decision-making; essentially working with other people's solutions instead of finding your own) (Table 1: section 1.1.2); and
- (c) *problem solving* (involving the ability to evaluate and analyse a situation with nothing given, identify and obtain appropriate methods and data and then apply the methods to solve the problem) (Table 1: section 1.1.3).

It is clear from the research that only technical professionals require high levels of *problem solving*. As a basic minimum, participants in the sector should at least be *numerate*. A lack of numeracy can have a significant impact on the quality of decision-making. It appears that most decision-makers in the water sector are numerate. However, examples of decision-makers not understanding why a water reservoir needs to be higher than the housing it services are in evidence. The level of knowledgeable analysis required to participate in the water sector is not clear. Some interviewees expressed concern at the low level of knowledgeable analysis demonstrated by decision-makers in the sector.

The participants' lack of comment or attention to *actively listening* to others (Table 1: section 2.2.1) is in our estimation a serious shortcoming. This appears to be a shortcoming in all parties in the developmental water service sector. It may be that this limits the technical professional's capacity to work with stakeholders, a difficulty raised by consultants and decision-makers in the interviews. In addition, not listening would clearly exacerbate decision-makers' inability to acquire the knowledge necessary for analysing and may lead to some of the frustrations technical professionals experience when their advice is ignored.

Technical professionals struggled to work well with stakeholders (Table 1: section 2.3.3) and it appeared to some interviewees that technical professionals could not always discern who the stakeholders were.

In general participants in the sector expressed concern at the low level of written communication (Table 1: section 2.3.4).

Judgement (Table 1: section 3) may be one of the most important competencies in South Africa where limited financial resources restrict the availability, choice and sustainability of services. Although it appears to the researchers that knowledgeable analysis, a business sense, active listening and working with stakeholders are key competencies in making sound judgements, the foundational basis for sound judgement remains unclear and was not a focus of this research.

While competencies are clearly a key characteristic of performance of individuals, and are a major focus of this investigation, there are a number of other characteristics which may provide methods and tools for understanding and improving the performance of individuals and disciplines within the sector, including (a) Thinking style; (b) Cultural orientation; and (c) Learning style. With regard to one of these aspects, namely learning style, although the sample size was small, it is particularly noteworthy that all four interviewees without hesitation indicated that they preferred visual (diagrammatic or pictorial) to verbal (written) communication. This is in line with the results of a number of international surveys on learning (Felder and Brent, 2005)¹, but in striking contrast to the format of presentation of most research outputs. Furthermore, evidence from a number of interactions indicates that high-level technical

¹ Felder, R M and Brent, R (2005) Understanding Student Differences, *Journal of Engineering Education*, Vol. 94, No.1, pp.57-72.

professionals and decision-makers in practice do not generally appear to be reading technical or research reports. This provides a very brief initial indication of individual preferences for *how* knowledge might be taken up, as against *what* knowledge is - or should be - taken up (which is the primary focus of this investigation).

New knowledge contributed by the project:

In summary the project contributed several new insights as follows:

- (a) The study developed and documented an exploratory methodology based primarily on in-depth interviews which enabled the collection of evidence on knowledge, context and individual competencies with respect to developmental water services.
- (b) The study established that for effective provision of water services within a developmental context, there is a close relationship between the three components of (i) knowledge/information (on developmental water services); (ii) context; and (iii) individual; and that it is difficult to address any one of the three components without reference to the other two.
- (c) The study established a number of simple preliminary frameworks as follows: (i) A framework to describe the key elements and characteristics of the workings of the bureaucracy as applied to developmental water services - effectively the contextual component of developmental water services; (ii) A framework of individual competencies for the developmental water services sector as a whole (including both technical professionals and decision-makers).

Recommendations for further research:

- (a) *Repeat the investigation* - i.e. literature review and in-depth interviews (possibly jettisoning the abbreviated surveys) - but *broader and deeper*.
- (b) Investigate the *political* dimension of 'developmental water services', and what it brings to 'developmental water services'.
- (c) Investigate the *workings of the bureaucracy*, how it may be stifling the exercise of competencies of individuals in addressing the challenges that confront the sector in the provision of developmental water services, and identify what interventions may be undertaken to rectify or improve the situation.
- (d) For points (a) to (c) above, an *ethnographic study method* (i.e. utilising a non-participant observer over a more extended period of time than an in-depth interview) may be utilised. Ethnography is about an outsider (researcher) making the unfamiliar events and practices of a community of practice, in this case local government offices and bureaucracies in developmental water services, familiar through observation and interviews. This involves recording and reporting activity that participants (who are too close to their business) no longer consider even noteworthy but may be a central aspect of the practice and may offer vital insight into the effective supply of services to consumers. Ethnography involves participant observation working with and alongside participants in the field.
- (e) Investigate the depth and nature of numeracy, knowledgeable analysis and problem solving that is displayed by and required of decision-makers, technical professionals, project managers and possibly even mid-level line management.
- (f) Following the above series of investigations of *what* knowledge uptake is - and ought to be - taking place, investigate *how* knowledge uptake is taking place - and *how* it might better take place.
- (g) Investigate *current vehicles* (formal and informal) for developing the necessary competencies for high-level decision-makers and technical professionals in developmental water services, as provisionally identified in the competency table. In particular, investigate the extent to which these competencies are developed by the time individuals exit from formal higher education institutions, as well as how these competencies are developed in practice.

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The Reference Group responsible for this project consisted of the following persons:

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Mr M Kolisa	Palmer Development Group
Prof A Lagardien	Cape Peninsula University of Technology
Ms L Ndlela	Palmer Development Group
Mr J Perold	Mawatsan
Mr P Pybus	Philip Pybus Consulting Engineer
Ms G Schoeman	Afrosearch
Dr A Shaker	NCWSTI
Mr M Singh	eThekwini
Mr F G Tsibani	DWAF
Ms I Wilson	Mvula Trust

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This project simply would not have been possible without the contributions of the ten or so high-level technical professional and decision-makers in the water sector, who participated as interviewees in the in-depth interviews or in the abbreviated postal/telephonic surveys. It has been a remarkable 'window' that their participation has opened for us onto that part of the water sector. We have specifically omitted their names - and the names of their organisations - in order to retain confidentiality. That in no way diminishes our thanks to them. We have made every effort to record and utilise their comments truthfully in both word and intention. However, if we have misunderstood or misinterpreted anything, the fault is ours and not theirs.

To others who contributed in other ways to the project - even if not through the interviews - we would like to express our thanks.

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LIST OF ABBREVIATIONS

ASCE	American Society of Civil Engineers
BEE	Black Economic Empowerment
c	concern
C	Councillor
CMU	Contract Management Unit
CoJ	City of Johannesburg
CPD	Continuing Professional Development
CV	Curriculum Vitae
DANIDA	Danish International Development Agency
DBSA	Development Bank of Southern Africa
DFID	Department for International Development
DPTE	Development Planning, Transportation and Environment
DWAF	Department of Water Affairs and Forestry
ECSA	Engineering Council of South Africa
ED	Executive Director
gc	grave concern
HBDI	Herrmann Brain Dominance Inventory
HR	Human Resources
ICC	Infrastructure Co-ordinating Committee
ICT	Information and Communication Technology
IDP	Integrated Development Plan
ISS	Infrastructure & Services Subcommittee
ITN	International training Network
JOWAM	Johannesburg Water Management Company
JW	Johannesburg Water
MBA	Master of Business Administration
MC	Mayoral Committee OR Methodical Competence
MSE	Municipal Services Entities
NCWSTI	National Community Water and Sanitation Training Institute
P&DM	School of Public and Development Management
SAICE	South African Institution of Civil Engineering
SANTAG	Kwazulu-Natal Sanitation Task Group
SC	Social Consultant
SCCP	Social Competence and Competence of Personage
SDA	Service Delivery Agreement
SHU	Shareholder Unit
SM	Senior Manager
TC	Technical Consultant
TM	Technical Manager
UK	United Kingdom
UNDP	United nations Development Programme
WEDC	Water Engineering Development Centre
WHO	World Health Organisation
WRC	Water Research Commission
WSA	Water Services Authority
WSP	Water Services Provider OR Water and Sanitation Program

1 INTRODUCTION

1.1 Background

Over the past decade or so in South Africa, there has been a fundamental change in the way in which services are provided, from an approach dominated by technical factors to one in which a range of factors other than purely technical factors are addressed. In this new approach, services are provided to meet developmental objectives, with an emphasis on poor communities. In the water field, a suggested term for this new approach is 'developmental water services'. This change has been acknowledged by the Water Research Commission (WRC) in its own knowledge review, where it observed that "...the sector is in transformation", pointing to a "shift in paradigm" as the challenges of integrating technical factors with other factors such as business aspects become more established (WRC, 2002: p.24, 31-32). The review went on to indicate that this is a relatively new field (specifically referring to Integrated Urban Water Management) and that human capacity is relatively low. The Development Bank of Southern Africa (DBSA) also identified the low human capacity in the sector and indicated that it intended "...to establish a knowledge institution [in the following] year with the aim of unlocking capacity of local municipalities" (Phasiwe, 2003). However, experience with students in several formal tertiary level courses and experience with practitioners in the field suggest that while there is fairly significant knowledge available within the research community on the change 'from technical design to developmental service provision', there appears to be insufficient uptake of this knowledge by technical professionals and decision-makers responsible for service provision (Van Ryneveld and McCutcheon, 1997). Knowledge uptake is defined here as 'the active acquisition of disseminated information, the comprehension of the information and the ability of practitioners to apply the information in the field'. Significant attention in recent years has been paid to the development of new organisational arrangements, policies, legislation and procedures for developmental water services. This exploratory study, by contrast, turns the attention to the uptake of knowledge by individual practitioners at the higher levels within the new service provision paradigm.

1.2 Study aims

The study aims are as follows:

1. To review the literature on the topics of (a) developmental water services provision; and (b) knowledge uptake and related factors, both individually and in combination.
2. To develop a methodology to identify how uptake of knowledge by technical professionals and decision-makers in developmental service provision in the water sector is taking place in practice.
3. To make an initial assessment of how knowledge uptake (as described above) is in fact taking place in practice, and to propose strategies to improve this.

The core question of the study was stated as follows: "Assuming that there is good information available and accessible on the topic of developmental water services, why are individual practitioners at the higher levels not acquiring, comprehending and applying that knowledge better, as evidenced by persistent service delivery backlogs and poor sustainability?"

The question really has three parts to it:

1. Is there (as assumed) good information available and accessible on the topic of developmental water services?
2. If so, is there a mismatch between knowledge available in the literature and knowledge taken up by individuals?
3. And if there is a mismatch, why is the knowledge available in the literature not better taken up by individuals?

A key objective of the study was to understand better what the problems were confronting individual technical professionals and decision-makers, and to make connections - if there were any to be made - between the problem in the *global* sense (of the sector having made good progress in terms of policy etc, but having performed less well in terms of delivery and sustainability) and the specifics of the problems confronting *individuals*.

1.3 Scope and emphasis

Within a topic as potentially broad as this, it has been necessary to establish the scope and emphasis of the project to make it both distinctive and manageable:

1. This study is *not* about knowledge management. Knowledge management is mostly institutional and relates to the institution's ability to access, organise and disseminate information. In contrast with research on dissemination, which has tended to approach the problem from the vantage point of the person or institution disseminating the knowledge, this project approaches the problem *from the vantage point of the person taking up the knowledge*. From the vantage point of the person taking up the knowledge, the topics of information dissemination and individual competencies are not incompatible, but rather complement one another. (More detailed discussion is continued below).
2. This study is *not* about capacity building. Capacity building is about the *growth* of knowledge, professional development and on-the-job learning. We are more interested in the practitioners' existing or *individual* competence to meet the *threshold* competencies required for developmental water services.
3. The study focuses on uptake of knowledge by *practitioners at the higher levels in the form of technical professionals and high-level decision-makers* (High-level decision-makers are generally politicians, and often non-technical).
4. One does not (and cannot really) measure directly what knowledge is taken up by an individual in the sense of what is acquired and comprehended by the brain; nor is it particularly important. Rather, as evidence that knowledge has been taken up, one measures what the individual can *do* with that knowledge. Knowledge uptake is therefore demonstrated through competence. In other words, we *measure* learning by measuring its results or the *output of the learning*, rather than by trying to measure the *process of learning*. This investigation has therefore concentrated on the *outputs* of learning rather than on the *process* of learning. This study is therefore *not* primarily about *how* the knowledge is taken up. Rather, the focus of the study is on the *knowledge taken up* and how it is demonstrated in practice.
5. While this investigation was a comprehensive survey of knowledge and competence, it did not provide detailed insight into the *extent or severity* of any lack of competencies (i.e. how widespread they were, or how severe they were). This investigation has simply developed a methodology and 'first pass' typology of knowledge and competence for

- practice.
6. While not ignoring subject-specific knowledge, we have attempted to focus on those generic competencies that provide the foundation for the subject-specific knowledge, rather than focus on the subject-specific knowledge itself.
 7. Notwithstanding the above, the scope of the project is *intentionally broad, focusing on breadth more than depth*. This is a relatively new research area, and it is considered important in the earlier stages of such an initiative to gain a broad understanding of the problem in its various facets before gathering detailed evidence on any single one of them. It needs to be stressed that the project is more of an exploratory investigation than one to provide definitive answers at this stage. The emphasis is on trying to identify the core problem, and to develop methodologies to assist with doing that. The methodology utilised, therefore, is one that provides the opportunity for taking a fresh look at the problem, and is very open-ended.

On the difference between knowledge uptake and knowledge management:

In focusing on knowledge uptake, the first emphasis is on knowledge uptake of the individual practitioner (although within the context of the organisation), rather than on knowledge management within the organisation.

From the literature review of their study on knowledge management in the construction industry, Dent and Montague (2004: p.12) found that "the different interpretations of knowledge, knowledge management, information, skill, learning, the learning organisation etc, are not helpful". So there is a difficulty with *definitions*. (And, to add to that, there are few studies that analyse and report on what organisations are actually *doing* to overcome the difficulties identified). With regard to a definition of 'knowledge management', Payne and Birchall (2003) suggest the following: "There is no 'killer' definition of knowledge management. In broad terms it is the successful application of concepts and practices that enable organisations to exploit and develop their knowledge assets to improve competitiveness and profitability". They go on to suggest that "...knowledge management practices generally fall into two categories: those that *connect people to information* and those that *connect people to other people*. Most organisations need a mixture of two, the balance depending on the objectives, strategy and culture of the organisation".

Notwithstanding this, Dent and Montague (2004: p.11) point out that it is the "...ability to *obtain, incorporate and employ* knowledge ...that provides competitive advantage, rather than the *ownership* of the knowledge itself" [*italics added*]. What they describe - specifically the ability to 'obtain, incorporate and employ knowledge' - is a key element of what has been termed 'knowledge uptake' in this study. Dent and Montague (2004) therefore start with the 'dissemination' side of the topic (i.e. knowledge management within the organisation), and end up concentrating on what it takes to get personnel to 'obtain, incorporate and employ the knowledge' - which has more to do with knowledge uptake of the individual practitioner, which is the focus of this particular study. The problem is described as follows: "In many cases companies already have in place a number of processes and tools for managing knowledge but are unable to inspire employees to use such resources on a consistent basis. This is very much the case for those companies undergoing rapid growth and continual internal development." (Dent and Montague, 2004: p.25). The description of 'rapid growth and continual internal development' would be apt for local government at the current time in South Africa.

Whatever definitions are used, this investigation does *not* focus on the institutional aspects of the topic, meaning the organisation's ability to access, organise and disseminate information. The term commonly used for this is *knowledge management*. Rather - to repeat the point - the study focuses on *knowledge uptake of the individual practitioner*. Where this investigation *does*, address the institutional aspects, however, is in the *context* within which the knowledge is exercised.

1.4 Research products

The output of the research in the form of a research report is *aimed at* the following individuals and organisations, in designing capacity-building programmes as part of transformation of the water sector to developmental service provision:

1. Individual technical water professionals and decision-makers;
2. HR departments of all water sector institutions, and particularly the institutions of those participating in the case studies; and
3. Academic institutions.

1.5 Overview of methodology

The methodology consisted of two primary research strategies:

1. a *review of the literature* on the topics of (a) developmental water services provision; and (b) knowledge uptake and related factors, both individually and in combination.
2. *in-depth case studies in the form of interviews and interactions* with 5 technical professionals and high-level decision-makers in the sector in urban/ peri-urban areas.

Two secondary research strategies were employed to support the primary research strategies:

1. The in-depth case studies were preceded by *observation of typical institutional arrangements and decision-making processes* mainly in local government, which (a) provided further insight into the nature of developmental water services, and (b) enabled the researchers to identify and obtain access to the *context* within which individuals were operating, as well as to appropriate and representative *individuals* for the in-depth case studies.
2. The in-depth case studies were then followed by an *abbreviated postal/telephonic survey* of knowledge uptake by technical professionals/decision-makers across the sector, including a further 4 individuals and consisting of about 10-15 questions, to obtain a slightly broader sample of views on the key issues identified within the in-depth case studies. (In practice, the abbreviated survey tended towards a number of additional in-depth interviews - albeit abbreviated).

The investigation focused on the individual, and explored the uptake - meaning the acquisition, comprehension and application in context - of knowledge on developmental water services. The three components, therefore, that the investigation explored were:

1. knowledge/information (on developmental water services);
2. context; and
3. individual.

The sequence in which these components were explored was as follows:

1. The investigation started with a literature review of *knowledge/information* on developmental water services.
2. This was followed by a literature review of knowledge uptake by the *individual*.
3. However, in investigating the *individual*, it was found that one could not make sense of the required characteristics of the individual without also investigating the *context* in which the individual was operating.
4. Investigation of the individual and context in turn led back to a re-examination of the *knowledge* - raising questions as to whether it was appropriate to the *context* (and to the *individual*).

Translated into question format, the above sequence was as follows:

1. What is developmental water services - and what *knowledge* is available in the literature on the topic?
2. What is knowledge uptake - and, similarly, what *knowledge* is available in the literature on the topic?
3. What knowledge *has* been taken up by *individuals* - and how do we measure that?
4. What knowledge *ought* to be taken up by *individuals* - and (tentatively) how do we determine that? (We didn't manage to clarify the difference between what knowledge was and ought to be taken up)
5. How does the *context* in which an individual is operating affect what knowledge he/she does take up and ought to take up?
6. And back to the beginning again: What is developmental water services (in the light of the investigation)?

Within the study, *knowledge* and *context* are addressed under the heading of Developmental water services in Chapter 2. *Individual* characteristics are addressed under the heading of Competencies and other individual characteristics in Chapter 3. A detailed description of the methodology is given in Chapter 4.

1.6 Map of the report

The structure of the report does *not* follow the sequence in which the various components were explored. Rather, the various components have been grouped into two main items as follows:

1. *What we found*; in turn split into two main components:
 - (a) A component focusing on the *knowledge/information* available on developmental water services and the *context* within which it is applied (Chapter 2: Developmental water services);
 - (b) A component focusing on the *individual*, and on the competencies (and other characteristics) evident in - or required of - individuals for the provision of developmental water services (Chapter 3: Competencies and other individual characteristics).

For each component, the literature review and the findings of the in-depth case studies have been integrated to produce a single output.

2. *How we got there* i.e. a description of the *methodology* (Chapter 4).

The report ends with conclusions and recommendations for further work (Chapter 5). Further detailed supporting material is included in the Appendices.

2 DEVELOPMENTAL WATER SERVICES

2.1 Introduction

The starting assumption of the investigation was a suggested definition of 'developmental water services' as 'the provision of water services, with an emphasis on poor communities, to meet developmental objectives'. Critical to this definition is that the provision of water services is considered to extend beyond merely technical - or engineering - design to include a range of other disciplines such as health, management, finance and others.

More than simply the extension of water services beyond technical design to include a range of other disciplines, water services has become highly contested terrain, which has moved it firmly into the political arena. Where previously many of the decisions around water services had been delegated to technical professionals, these are now firmly held by politicians under the new service provision paradigm.

This has led to a marked division of roles between technical professionals and politicians (local authority councillors) as follows, tightly controlled within the bureaucracy:

1. Implementation of services on the ground carried out by technical professionals (in different fields such as engineering, health, housing etc., often arranged institutionally into departments along those lines);
2. Most decisions, trade-offs and resource allocations carried out by politicians.

A suggested diagrammatic representation of this is given in Figure 2.1:

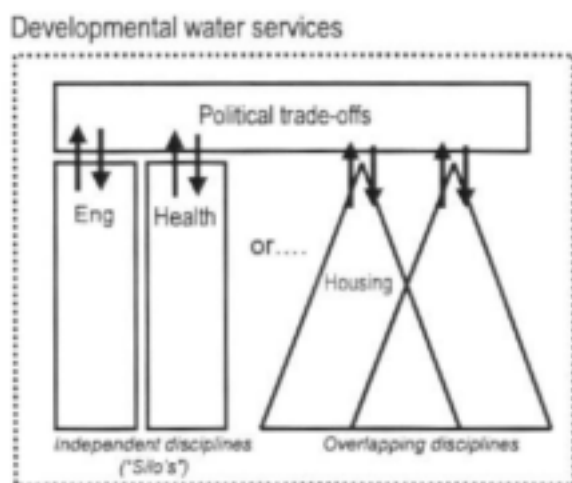


FIGURE 2.1:
SUGGESTED DIAGRAMMATIC
REPRESENTATION OF
DEVELOPMENTAL WATER SERVICES

These topics are described in more detail and further developed in the rest of the chapter, addressing both (a) the knowledge/information available on the topic, and (b) the context within

which it is applied; with evidence drawn from three sources: (a) the literature, (b) observation of the institutional arrangements and decision-making processes, and (c) in-depth interviews with individuals.

2.2 Review of the literature on developmental water services

One of the first tasks of the research was to carry out a brief review of the literature on developmental water services, which was carried out under five headings:

1. Curricula of tertiary level institutions;
2. Information and training materials;
3. Booklists and bibliographies;
4. Organisations and websites;
5. SA government policies and related documentation.

The review (included separately in Appendix A) appeared to confirm that there was fairly substantial and accessible (i.e. available on the Internet) information available on the topic.

Questions initially raised by the researchers as to why uptake of this knowledge had not taken place as well as one might have liked - as evidenced by service backlogs and poor sustainability - focused first on the *identification and acquisition* of the knowledge, including topics such as:

1. *Access to the information:* The internet may not be as user-friendly as it might appear at first sight. Download times can be long, and simply surfing the internet trying to find what one wants can be extremely time-consuming.
2. *Format of the information:* There may be a difficulty with the format in which the information is available, which may make it difficult to assimilate. There may simply be too much information, or it may be poorly graded i.e. there is a poor progression from overview to detail. Alternatively, the information may be too general - or too specific - and there is a difficulty in translating the information into actions or procedures that can be applied.
3. *Cross-disciplinary nature of the information:* The information appears in certain instances to straddle traditional disciplinary boundaries, and potential users may for a variety of reasons experience difficulties in operating outside their traditional domains e.g. They may have a framework or mental map of the topic that is not sufficiently well developed to permit them to explore these new areas, or their underlying generic competencies may be weak in certain respects.
4. *Workplace obstacles to sourcing the information:* There may be obstacles arising from their workplace or organisation. The organisation may be understaffed, and the workload simply too high, so that they simply have no time to get on top of new information. Alternatively, formally assigned roles and responsibilities of the organisation may make co-ordinated interdisciplinary action difficult.

However, the investigation soon moved to the *application of the knowledge within the required context*, and to the *appropriateness* of the information to developmental water services. Something appeared to be missing. What it was, however, was not initially clear.

Wooldridge and Cranko - trade-offs

A first indication of what may be missing is articulated by Wooldridge and Cranko (1997: p.340), who suggest that "...the state's core mission [is] to represent society's interests through the *delivery of goods and services in a context of managing conflicting interests*. The management of conflicting interests is not a neutral exercise, rather it is rooted in the promotion of the interests and values that constitute the particular mandate of the elected representatives in government." [italics added]. What is suggested is that the political discipline (which at the highest level in local government takes the form of the Mayoral Committee) plays the specific role in strategic decision-making of *allocating resources and making trade-offs* between the different technical disciplines - and appears to be what is missing from the conventional literature. This appears to be a reflection of the highly politicised nature of service provision in South Africa.

More detailed literature on decision-making and trade-offs appears in some of the management literature in particular. While it does not appear to bring substantial advances to the discussion, it does give some further insight into particular aspects of decision-making and trade-offs, and is included below:

Trade-offs: Hammond et al. (2001) highlight the need for trade-offs in decision-making and propose a variation on the method suggested by Benjamin Franklin by permitting an assessment of different characteristics in 'common currency'. Certainly within the context of developmental water services in South Africa at present, there *are* tradeoffs to be made in strategic decision-making - generally, it seems, between financial sustainability and a range of other variables e.g. environmental sustainability or progressive realisation of human rights. The method of "even swaps" (as Hammond et al. call it) does, however, seem a bit complicated for strategic planning in infrastructure.

Systematic approach: Stryker (2001a and 2001b) provides a case study to illustrate a systematic approach to decision-making which requires all elements of the problem to be set out under 'what', 'where', 'when' and 'extent', and whether it is part of the problem or not, in order to narrow down the problem. Interestingly, the elements of 'what, when, where, how, and with what resources' are also suggested to form part of *strategy* (Van Ryneveld, 2003: p.4).

Interpersonal barriers: Argyris (2001) in 'Interpersonal barriers to decision making' makes the interesting observation from research that there is a gap between words and actions of management in decision-making meetings: "In short, the executives vote overwhelmingly for executive systems where contributions ...can be maximised...Nevertheless the behaviour of these same executives tends to create decision making processes that are not very effective" (Argyris, 2001: p.61). He asks: "Why the discrepancy?" (Argyris, 2001: p.64), and points to three basic values held: (a) emphasis on 'getting the job done' [i.e. *task focus rather than group maintenance*], (b) *cognitive rationality emphasised; feelings and emotions played down*, (c) relationships most effectively influenced by *unilateral direction and control* (implicit in the chain of command). Argyris (2001: p.82) reports the somewhat sobering results that in a study of 60 top executives, "Learning about these problems by listening to lectures, reading about them, or exploring them through cases is not adequate; an article or book can pose some issues and get thinking started, but - in this area at least - it cannot change behaviour." What he also observed (Argyris, 2001: p.81) is that "...the forces towards ineffectiveness operate most strongly during the important decision making meetings". Argyris makes it clear that he can provide little in the

way of solution to these problems. He suggests the value of posing *questions*, and of working at *improving group effectiveness* (pp.82-87). Another interesting comment that he makes (p.86) is that "...the chief executive officers in these studies are rarely observed making policy decisions in the classic sense, viz., critical selections from various alternatives and determination of future direction to be taken".

Nosich - discussion of disciplines

Nosich introduces the notion of a discipline. What is suggested here is that developmental water services is an *agglomeration of a number of different disciplines*. Each of these disciplines e.g. engineering, environment, health etc. operates to a greater or lesser degree as an independent 'silo'. Each of these disciplines operates with its own *logic* (Nosich, 2001: p.53). As Nosich describes it: "There is, unfortunately, a common impression that a field is essentially a body of information....Practitioners in a field - at whatever level of education - do not simply possess information. Rather, they know how to use that information as well as the concepts that structure it....A field or discipline embodies a way of thinking about the world, a way of solving problems and answering questions....A good way to describe practitioners is to say that they have ownership of the logic of the field." Nosich (2001: p.55) goes on to suggest that a way of getting at the logic of a field is by "...learning the vocabulary of the field, grasping the fundamental and powerful concepts of a field, and thinking in terms of the central questions of a field".

Elder and Paul - different types of question

Also following a 'critical thinking' approach, Elder and Paul (2002, p.8) give further insight into the difference between the technical and the political disciplines within developmental water services by introducing the notion of different *types of question*. While this requires further investigation in practice, it appears probable that the technical and political disciplines will tend to be characterised by different *types of question*: "In approaching a question, it is useful to figure out what type it is. Is it a question with one definitive answer? Is it a question that calls for a subjective choice? Or does the question require us to consider competing answers?":

1. questions of procedure (settled by facts, by definition, or both);
2. questions of preference (as many answers as there are different human preferences);
3. questions of judgement (questions requiring reasoning, but with more than one arguable answer).



FIGURE 2.2:
TYPES OF QUESTION (Elder and Paul, 2002: p.8)

Technical considerations are generally ‘one system’ questions. Political considerations are generally ‘conflicting systems’ questions.

Combining the three ideas of (a) trade-offs; (b) disciplines; and (c) different types of question... yields a more accurate description of the concept of developmental water services within the local authority consisting of an agglomeration of different disciplines - both political and technical; with the technical disciplines focusing on implementation, and the political discipline focusing on making decisions and trade-offs and allocating resources between the different technical disciplines to achieve policy objectives.

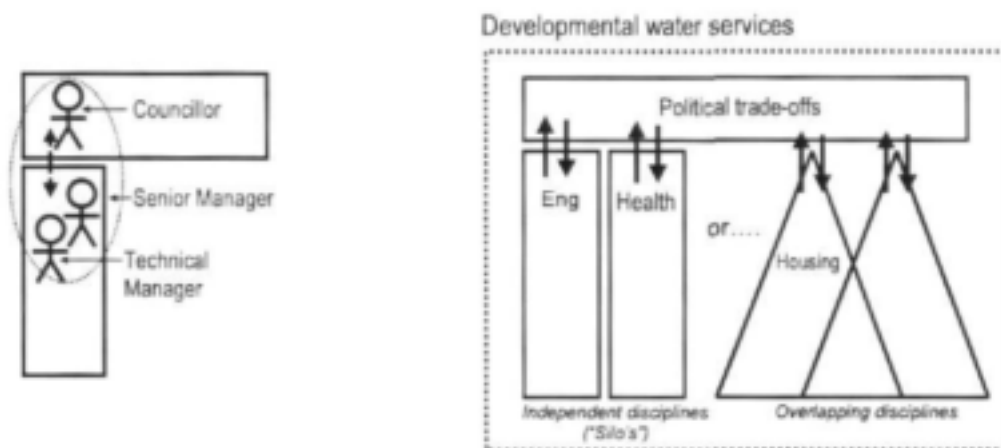


FIGURE 2.3:
DETAIL OF HIGH-LEVEL INDIVIDUALS IN DEVELOPMENTAL WATER SERVICES

Workings of the bureaucracy

Disciplines alone, however, do not give the complete picture. What makes it much more significant is that the arrangements are strictly formalised within the workings of the *bureaucracy*. Wooldridge and Cranko (1997: p.338) go on further to describe the workings of bureaucracies like local government from the policy end towards the implementation end as follows: "Rational bureaucratic administrations close off the space for flexibility and innovation within administrations, through the use of regulatory mechanisms. At the micro-level officials and front-line workers are tied down by narrowly defined job descriptions, and interactions between politicians, officials, management, and front-line workers are regulated by the rigid hierarchy, staff codes and regulations. Similarly, at the macro-level the ultra vires principle limits the scope of what can be done, and therefore the administration may only act in terms of the confines of the competencies as described by law."

Paul and Elder - complexity + thinking things through

Paul and Elder (2002: p.1) challenge us to become critical thinkers, suggesting the following: "Traditionally, our thinking has been designed for routine, for habit, for automation and fixed procedure. We learned how to do our job, and then we used what we learned over and over. But the problems we now face, and will increasingly face, require a radically different form of thinking, thinking that is more complex, more adaptable, and more sensitive to divergent points of view." Firstly, therefore, they are suggesting that what we face requires thinking things through afresh.

They go on to give the example of the problem of solid waste management (in an American context): "This problem involves every level of government, every department: from energy to water quality, to planning, to revenues, to public health. Without a cooperative venture, without bridging territorial domains, without overcoming the implicit adversarial process within which we currently operate, the responsible parties at each tier of government cannot even begin to solve these problems. When they do communicate, they often speak from a position of vested interest, less concerned with public good than in furthering a self-serving agenda." They suggest the crucial importance of the intellectual ability to think through these complex problems, and suggest further: "Without a grasp of the political realities, economic pressures, and scientific data (on the physical environment and its changes) - all of which are simultaneously changing as well - we cannot reverse the trend of deterioration of the quality of life for all who share the earth." (Paul and Elder, 2002: p.3-4).

Combination of technical and policy components

The notion of combining technical and policy components is one that has started to gain acceptance in some areas at an academic level: Creighton (2004) has described recent developments in the United States whereby "...Engineering schools are responding to the need for grads with both technical and public policy know-how". Combining skills in the form of double degrees is well-established in Australia, where at universities nationwide, the number of students taking combined degrees ranges between 20% and 60% (Pritchard, 2003).

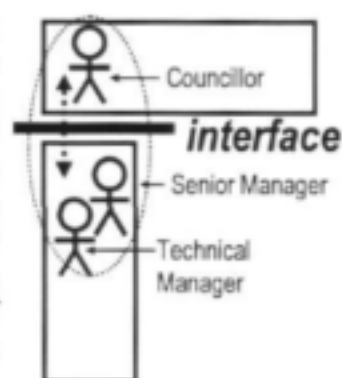
Communication between disciplines/groupings

Sound knowledge uptake requires a sound understanding of the functions and characteristics of both sides i.e. the political and the technical - whichever side one is coming from, and therefore an ability to both *obtain from* and *communicate to* the other party the appropriate information.

The starting point for this is to recognise that there *are* quite distinct differences between the two; and there are good indications of differences in the literature. Payne and Birchall (2003) have pointed out that there *are* organisational cultural barriers to sharing experience: "Many attempts at knowledge management in civil engineering have focused on purely technological solutions such as intranets, project extranets and databases." They go on to point out that many of these attempts have not been fully successful. In their studies, they have found that the barrier has been an unwillingness on the part of many to share experience, or use a common database. They suggest that "...for people to share their own knowledge and use knowledge generated by others, they need incentives and processes to help them overcome traditional 'knowledge is power' and 'not invented here' behaviours." The important point is that they suggest that there *are* cultural barriers to be overcome - even if their context is slightly different to the South African one. Saywell and Cotton (1999: p.20-21) list barriers to effective dissemination as including organisational, practical and psychological considerations.

Interface

The *interface* between the individual technical disciplines (which are usually organised in departments, consisting of officials who are generally technical professionals) and the top political decision-making bodies is a critical one. It is at this interface that the most critical communication - and decision-making - happens at local government level, and which has the most far-reaching ramifications in both directions in the organisation: towards the policy side in the one direction; and towards the implementation side in the other direction. Where does this fit into the diagram of a typical institution and of key personnel within it? This is illustrated at right:



Although this interface has been selected as the focus of this particular investigation, there is in fact a second interface with two components that was pointed out by the Technical Consultant which is the interface between the bureaucracy and the *community*. The interface or link between the bureaucracy and the community is in fact a dual one: (a) from the politicians to the community; (b) from the officials to the community; each of which takes a slightly different form.

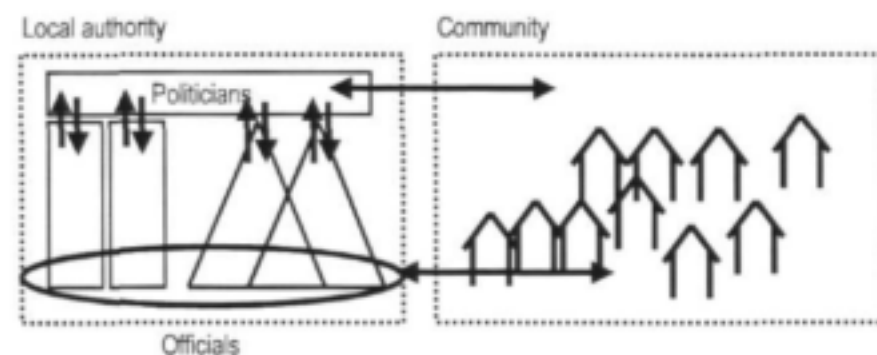


FIGURE 2.5:
DUAL LINK BETWEEN LOCAL GOVERNMENT BUREAUCRACY
AND COMMUNITY

2.3 Observing the institutional arrangements and decision-making process

As described in the Methodology chapter (Chapter 4), the in-depth case studies were preceded by observation of typical institutional arrangements and decision-making processes - mainly in local government, which (a) provided further insight into the nature of developmental water services, and (b) enabled the researchers to identify and obtain access to the context within which individuals were operating, as well as to appropriate and representative individuals for the in-depth case studies.

The case of the City of Johannesburg is used by way of illustration. It should be stressed at this point that while the City of Johannesburg is used as illustrative of typical institutional arrangements and decision-making processes, the individuals interviewed in the in-depth case studies in fact came from a *range of organisations*, and no link between the individuals interviewed and the City of Johannesburg should therefore be inferred.

The institutional arrangements for water services in the City of Johannesburg are described as follows, as illustrative of a local government bureaucracy¹:

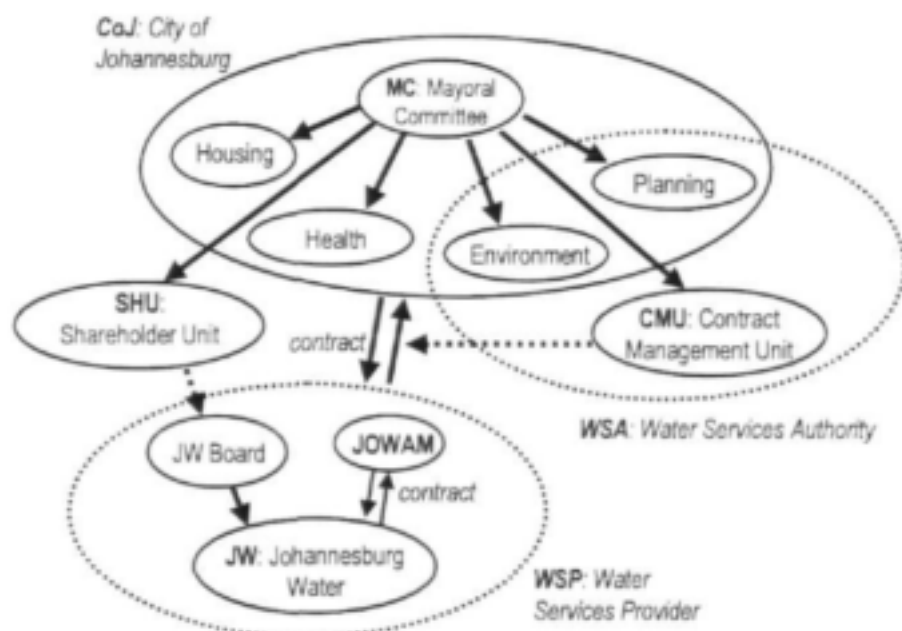


FIGURE 2.6:
INSTITUTIONAL ARRANGEMENTS OF THE CITY OF JOHANNESBURG

¹ It should be noted that the governance structures and institutional arrangements of the City of Johannesburg as described here (including the committee structure, contractual arrangements, decision-making model at Mayoral level etc.) are all currently undergoing a process of review and change, following the elections of March 2006 and the decision of the Board of Johannesburg Water Pty Ltd on 7 September 2005 not to extend the 5-year management contract of JOWAM when it expires on 30 June 2006. (Johannesburg Water, 2005; Cele, 2006).

The entity termed 'City of Johannesburg' is the core local authority body, consisting of a Mayoral Committee, which is the main decision-making body of the local authority, and to whom a number of departments within the City report e.g. Housing, Health, Planning, Environment etc. The Mayoral Committee is probably the key point of interaction between politicians and technical professionals.

For the provision of water services, the City has chosen to set up a Proprietary Limited company, Johannesburg Water (JW), in which the City is the full shareholder. All water services-related assets of the City were transferred to Johannesburg Water - as were a large proportion of City personnel involved in water services. The relationship between the City and Johannesburg Water is governed by a Service Delivery Agreement (SDA) or contract. The contract, in turn, is regulated by the Contract Management Unit (CMU) of the City. The Shareholder Unit (SHU) appoints the Johannesburg Water Board and is responsible for ensuring that the City's interests as shareholder in Johannesburg Water are looked after.

While the portfolio of Water Services Authority (WSA) Manager has been assigned to the Executive Director: Development Planning, Transportation and Environment (ED: DPTE), the actual WSA functions are carried out jointly by DPTE and CMU (with certain functions carried out by SHU as well).

In addition to this, Johannesburg Water has entered into a contract with a management contractor, JOWAM, to manage JW and build capacity for a limited period (provisionally for 5 years, from 2001 to early 2006).

From a decision-making point of view, the City of Johannesburg is both big and complex. Although the Mayoral Committee is the primary seat of decision-making, many of the decisions are confined to at least some degree by the prior contractual arrangements between the various entities in the City. The City can, of course, choose to override these contractual agreements. However, there is an invariably a financial cost attached to such an action.

Other than to focus attention on the Mayoral Committee (and to a lesser degree, on other policy-setting bodies or instruments), the institutional arrangements do not really shed much light on the actual decision-making process. That is better described by the reporting lines of the various committees up to final decision-making at the Mayoral Committee, which are presented diagrammatically in Figure 2.7 with explanation following:



FIGURE 2.7:
**REPORTING LINES OF DECISION-
MAKING COMMITTEES IN THE CITY
OF JOHANNESBURG**

The Infrastructure Co-ordinating Committee (ICC) is the most senior committee made up of officials (as distinct from politicians) that prioritises and co-ordinates any infrastructure development initiatives in the City from the perspective of officials (which include most of the infrastructure-related technical professionals in the City). City departments such as Planning and Housing are represented on this committee, as are the utilities such as Johannesburg Water.

Once an agreed view of officials has been obtained from the ICC, a report is submitted to the Infrastructure and Services Subcommittee (ISS), with accompanying presentation. This committee is attended by both official and politicians. It is a first opportunity for the politicians to have sight of any issues before it gets to the Mayoral Committee. Once a report has been passed by the ISS, it tends to have a smooth ride through Mayoral Committee.

The role of the Section 80 Committees is slightly different. They are portfolio committees, attended by councillors from the full spectrum of political parties. Discussion therefore appears to be characterised more by party-political sensitivities than the ISS.

The Mayoral Committee - as indicated earlier - is the top decision-making body of the City. The committee usually has a substantial agenda. Documentation is substantial (a 'telephone directory-sized' pile of reports); and time for presentation and discussion is limited. Time for presentation and discussion is relatively short for all committees: typically 15-20 minutes of presentation, followed by 10-15 minutes of discussion. Usually the more senior the committee, the tighter the time, and the more diverse is the audience!

Conclusion

The major conclusion from observing typical institutional arrangements and decision-making processes is the critical importance of the Mayoral Committee/Executive Mayor in decision-making for developmental water services. Although the specific institutional arrangements of the City of Johannesburg - specifically the setting up of a separate WSP in the form of Johannesburg

Water - are somewhat unusual by South African practice, the key position of the Mayoral Committee/Executive Mayor *is* typical of other local authority arrangements.

2.4 Detailed analysis of in-depth interviews

Focus of the interviews:

The interviews focused on the *interface* between political decision-makers and technical professionals.

Five individuals were interviewed as follows, and illustrated at right:

1. Councillor (political);
2. Senior Manager (managerial);
3. Technical Manager (managerial/technical);
4. Social consultant (managerial/social);
5. Technical consultant (managerial/technical).

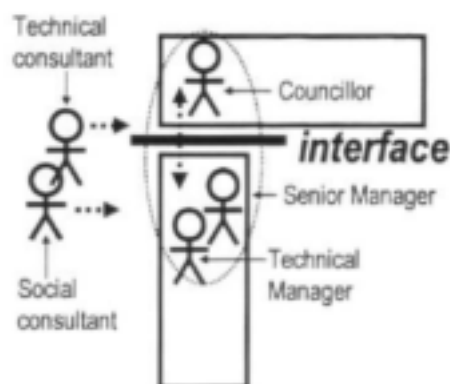


FIGURE 2.8:
INDIVIDUALS INTERVIEWED

Classification categories for 'context':

In analysing the comments from the in-depth interviews from the perspective of the *context* within which individuals are operating, the three components of *developmental water services* identified earlier in the study emerged as overwhelmingly dominant, namely:

1. Implementation of services on the ground carried out by technical professionals (in different fields such as engineering, health, housing etc., often arranged institutionally into departments along those lines);
2. Trade-offs and resource allocations carried out by politicians; and
3. The institutionalisation of this, or translation into the bureaucracy.

Virtually all comments from the in-depth interviews relating to the context within which individuals were operating could be grouped into two (or possibly three) main categories:

1. Interactions across the interface between politicians and officials/technical professionals - nominally '*down the hierarchy*';
2. The making of trade-offs and key decisions of principle, requiring prioritisation between different projects and different departments - nominally '*across the hierarchy*'.

..and a third category of characteristics which applied to both categories:

3. *Characteristics* and requirements (applying both down and across the hierarchy)

One further minor category of 'External requirements/constraints' could be added, but is really too small to be significant.

In each case, comments related to the particular function as well as to the institutionalisation of these or translation into the bureaucracy.

The following diagram depicts the local authority - consisting of officials and politicians within a hierarchy - interacting with the community in the provision of services, indicating the interactions '*down and across the hierarchy*'.

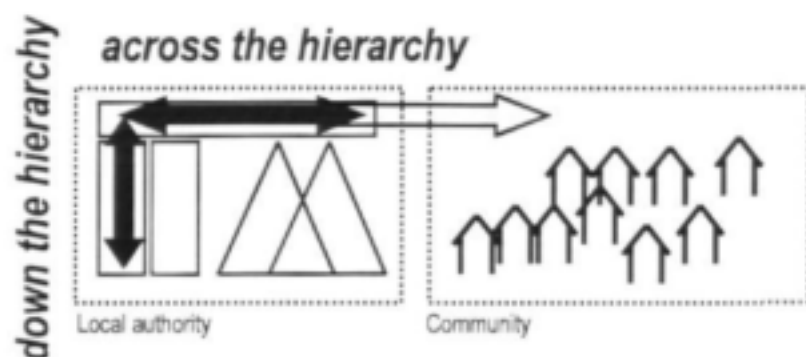


FIGURE 2.9:
DIAGRAMMATIC REPRESENTATION OF 'DOWN' AND
'ACROSS' THE HIERARCHY

Category#1: Interactions across the interface between politicians and officials/technical professionals - nominally 'down the hierarchy' (from politicians to officials):

Within Category#1, there appeared to be two main themes or sub-groupings:

1. Translation or conversion from: (a) policyto delivery; (b) generalto specific; (c) abstractto concrete; (d) purposeto technique²; and (e) non-technical.... to technical
2. The bureaucratic aspect of this translation, namely (a) delegation of authority, and reporting in reverse; (b) allocation of resources, specifically budget allocations, and reporting on budget expenditure in reverse.

Conversion from policy to delivery and abstract to concrete was expressed by the *Councillor*:
 "...this is an attempt from the perspective of [particular local authority] to translate this constitutional obligation into reality." - *Councillor*

A similar comment was repeated by the Social Consultant:

"...politicians...are supposed to see that the Constitution is translated into tangible things." - *Social Consultant*

A number of practical examples, both abstract and concrete, faced by the local authority - as well as the difficulty of resolving them and translating from general-to-specific or abstract-to-concrete and vice versa - were articulated by the *Councillor* [Summarised/paraphrased in several places]:

- How is 'a household' defined? (is it defined by an erf? what if there are five more shacks at the back of the erf?)
- Is 6 000 litres per household per month sufficient?
- What if you have got a large extended family?
- What if you are using full-flush sanitation (using 10-15 litres of clean water per flush)?
- These households are generally poor, underemployed or unemployed altogether.

² See Benson (2006): 'For many years now, there has been, at every level of society, a growing gap between the techniques of disciplines and the purposes of disciplines. We have been learning how to do particular things, in other words, but not what they are for'.

"Until now we have been sustaining this through cross-subsidisation...The reality is that you end up with at least 25 percent of your large water users cross-subsidising everybody else. But if you grow the number of dependants, [it] is just not sustainable, so then that remains one of the challenges."

- Who is poor? do we use a means test to determine that?
- Sewer blockages, as a result of using newspaper for toilet paper.
- The need for educational awareness.

- *Councillor*

Virtually all of the above examples are divergent problems in a technical context. They are policy and planning problems, but are not (in the first instance) spatial planning problems. Nevertheless, if you don't understand the technical implications of these problems, then you are equally in trouble. Many of the problems that now confront a local authority or service provider are planning and technical problems intertwined. In most conventional civil engineering projects, the planning precedes the engineering in a fairly sequential manner. It seems that in services provision, there is a much closer ongoing interaction between the planning and the engineering. The day-to-day issues raised by the *Councillor* are not resolved once-off before proceeding to service delivery. They arise, unfold and are resolved in the course of a service delivery programme. They have implications for the technical work, but are not generally in themselves problems that can be resolved by technical means - or by technical means alone.

Another example of a practical problem illustrating the difficulty of translating policy into delivery and abstract into concrete was given by the *Councillor*. It was a case where several hundred people had illegally invaded land, but nevertheless have the right of access to water and sanitation:

"...if you want to be legalistic about it, they are illegal, but that does not take away their right to have access to water and sanitation. ... It is a very complex thing. It's a very practical thing". - *Councillor*

The point is made that there is significant complexity in the specifics of these issues as encountered on the ground. One generally tries to deal with the complexity on the ground by making in-principle decisions. But to translate the general into the specific on the ground, and to translate the specifics of what is happening on the ground back into general terms is extremely difficult.

The different responsibilities of technical and non-technical personnel was raised by the *Social Consultant*, with particular reference to ward councillors:

"You get a sense that they ... have got a grasp of what this project is all about [and] what it is supposed to deliver. In terms of your technicalities you leave that to your engineers or your technical team...They can [take] you to task if you try and give them something that is not in line with what they are supposed to be getting. ... I can tell you they are ...sharp. Where they get that sharpness from, I don't know." - *Social Consultant*

What he also points out is that while the ward councillor may not be strong technically, he nevertheless has a good understanding of what he wants - presumably in general terms - and knows when he is not getting it.

Two key procedures are used to work these processes into the bureaucracy. The first is delegation of authority:

"Councils are strong on delegations, and what is delegated from Council level down...

There are layers of delegation, and you have to get that right. Any organisation has that and you tend to find that in formal organisations, while everyone says that they all work well - and they all do - they end up fighting about those things they haven't clarified. You have to clarify certain matters." - *Senior Manager*

Delegation of authority is generally accompanied by reporting back in return on what has been delegated, which has its own difficulties:

"...a lot of time is being sucked away from your job in this kind of organisational bureaucracy. It is dysfunctional reporting. It hasn't been streamlined enough. It hasn't been made simple enough....If you do this stuff, it drives you nuts, like doing ten tax forms simultaneously." - *Senior Manager*

Lack of delegation of authority - or politicians trying to micro-manage the detailed implementation:

"I think without trying to manage the politicians, they will manage you, and when I say they will manage you, they try and manage your [capital expenditure] programme in a way that has no engineering or service delivery logic. They will basically say 'But why haven't we got more money spent in that area?'. That is the essence of their view of life. '...That ward there, you haven't spent money. Where is the pipe?...' and from that point of view, there hasn't been activity. There hasn't been soil turned. 'So where is someone employed? I haven't been able to cut a ribbon.' etc. You have to try and get them out of that detail." - *Senior Manager*

This comment also gives an indication of the grey area that separates what is good for the politician as against what is good for the local authority as a whole.

Another example where lack of delegation of authority results in delays was given by the *Social Consultant*:

"...if you have a project that was approved and passed by Council...[and] for example, [as a result of] unforeseen circumstances on the ground ...you go beyond your budget...and need to increase the budget; [then even if] you have the funds within the programme, ... you still need to have that OK [from the Council]. [And even if it means that] the contractors were delayed because of stopping work [waiting for the Council decision]...you don't want to act because if you do you might be punished...[S]o you have got to work [within] those kind of systems." - *Social Consultant*

Budget allocations and control of the budget is a critical aspect that accompanies delegation of authority. One of the ways that authority is delegated is in terms of the size of a single order that can be authorised. A fairly long discussion followed with the *Technical Manager*, explaining the levels of authorisation:

"There is a certain threshold [of the order of R100 000] for a single order, above which an order has to be authorised by the executive. It is unusual for that to be exceeded unless it is a capital expenditure item, or unless it is a large occasional order of a routine item e.g. chemicals." [Paraphrased:] The point was also made that circumstances do arise where significant over-budget expenditure may be required on a particular item. When that happens, one will have to cut the budget somewhere else and cross-subsidise. One cannot simply overrun the budget. - *Technical Manager*

The *Technical Manager* explained the matter further as follows:

"When you don't fundamentally understand how you set up that budget in the first place,

when things go wrong and your budgets start overrunning, you are clueless as to what is happening. So that's really important to understand that." - *Technical Manager*

...and again:

"So I think one needs to have a view of the [organisation] as a whole, [particularly] when you are at an ... executive position. It is not just what your department does which is ... important. You must understand how your department impacts on other departments, and impacts on the [organisation] as a whole. ... To me, that type of thing is very important." - *Technical Manager*

The comments are significant from two points of view: Firstly, budgetary control is critical; and secondly, things often don't go exactly as planned, and need adjustment.

Category#2: The making of trade-offs and key decisions of principle, requiring prioritisation between different projects and different departments - nominally 'across the hierarchy'.

Within Category#2, there appeared to be three main themes:

1. Conflicting objectives;
2. Trade-offs and prioritisation within limited resources;
3. Risk and mitigation of risk.

The issue of limited resources was well described by the *Social Consultant*:

"Everyone would want to be in this first-world economy, where if you feel like having five bathrooms you can do that if you can afford to do that, but the limiting factor now is around the resources that you have got, even [if] you have got the facilities within your neighbourhood, because there are issues around the payment for that." - *Social Consultant*

Because of limited resources, it is not possible to achieve everything all at once. Prioritisation is obligatory. In several instances (particularly in instances described by the *Senior Manager* and *Technical Consultant*) a common feature was that the individual had in the pursuit of their own responsibilities selected particular high-profile initiatives for priority attention, and had then focussed significant effort in these initiatives.

And in prioritising, trade-offs between conflicting objectives are necessary:

"...[the demands] all pull in different directions. Basically, if you wanted more of this [or] these you would have less of these...and that seemed to me a very difficult thing for [the politicians].... It would be a different day of the week and they would be shouting about a different one of these things." - *Senior Manager*

The *Councillor* was very aware of the need for trade-offs and prioritisation within limited resources, using the term "schizophrenic" to describe the tension between wanting services to be delivered to an acceptable standard on the one hand, and wanting the delivery to be financially sustainable on the other. - *Councillor*

On the effectiveness of politicians in making these trade-offs, the *Senior Manager* commented as follows:

"Politicians don't understand trade-offs easily. They want it all. They are wonderful people. They want the wife and four girlfriends all at once on the same budget." - *Senior Manager*

But the difficulty of doing this was described in some detail by the *Councillor*. He described the process of establishing a political position and getting community acceptance on a difficult issue, and explained well the difficulty of establishing such a position when views are not uniform:

"Technically the solutions are not difficult, but the issues of getting buy-in, your technical people are not going to do that. You must clear the politics. You deal with the household. After the household is OK, the technical people will do what they do best... You have all these political agendas. So it meant that I had to work through my own [political party] caucus first. You know you are not going to get 100% support. If you've got 51% support, you're happy. You move on. You engage with others and eventually get to a point where you fix on a position and it gets through; and it does not end there. You must be accountable. You must be able to prove that it is working, and if it is not working it is your neck on the block. The party wants the assurance that - yes, we support you, but - if this thing explodes, you carry the can. Practically, that is how these decisions are taken, because I would be lying to you if I would say that we are all happy and all behind it. There is not such a thing." - *Councillor*

The *Social Consultant* described in some detail the difficulty of establishing community priorities as follows:

[Paraphrased:] (a) In the IDP processes, communities will come up with a shopping list of what they want. The Council will then have a certain amount of money and will have to cut the list to fit the budget. The choice of projects within the list is generally made by the Council with reference to total funding available together with rules laying down what can be done with funds from different sources. When services or projects are actually delivered, communities often comment that the particular service or project is not their priority, but they will have it anyway otherwise they won't get anything in the next allocation. (b) A second problem is that a politician may visit an area on a tour and make a comment that he would like to see something in particular (e.g. a settlement with the full range of services and amenities). The official then responds to the politician's expressed wish, even if the community has asked for different priorities. Again, the community will never refuse the services and amenities, but when they are built, they may be vandalised. Communities then say that the amenities are nice, but they are not an immediate need. - *Social Consultant*

The matter can be further complicated by the difficulty for politicians to separate out what is good for the local authority as a whole as against what is good for their own individual ward:

[Paraphrase:] Although the ward councillors are supposed to represent the interests of their communities, human nature does come into play in the prioritising of projects, so that even though particular items may have been identified by communities as being priorities, there is a tendency for ward councillors to prioritise projects from their own areas where resources are limited. - *Social Consultant*

Not only are there different views and expectations at local level, but there are externally imposed demands as well. The *Councillor* mentioned the externally imposed political imperatives, listing the "very stringent" national goals that have been set in the form of deadlines for backlog eradication as follows:

- (a) 2008: everybody must have access to clean drinking water;
- (b) 2010: everybody must have access to a minimum level of sanitation;
- (c) 2012: everybody must have access to electricity;

- (d) 2014: halve poverty and halve unemployment.
- *Councillor*

Several other interviewees also commented on what it takes to get a difficult political decision taken. One requirement is simply time and experience:

"This whole level-of-service debate, you could not have got 10 [or] 12 years ago. The same politicians would not have accepted it as they do now. That is only experience, you know." - *Senior Manager*

A second requirement is a strong champion or driver:

"I tend to think that [for a politically difficult decision to be made], you have to have a strong driver from the operations point...someone who wants it made, and you have to have a politician who wants it made - and sufficient credibility and ability to take it through." - *Senior Manager*

A third requirement, which often appears not to be possible, is freedom to make decisions. This would imply the delegation of the necessary authority.

On the matter of trade-offs, the *Senior Manager* suggested that "...most people, if they are spending their own money and they have got limited money, make a common-sense decision about [trade-offs]...but I don't think they are always given the freedom to think in that manner." - *Senior Manager*

One of the critical requirements in resolving these difficult political is for technical professionals to communicate the consequences of particular courses of action. The *Senior Manager* puts it as follows:

"I think information that you can give to a politician is to show them ... the consequences [of particular courses of action]." - *Senior Manager*

To do that, in the first instance, requires strong technical skills and experience in understanding and foreseeing the details of different possible events and their consequences:

"... looking at various aspects of risk ... always comes up, and whether you do it ... subconsciously in your mind, you probably do look at risk and things like that every single day of your life... There is a more structured way of looking at risk from the executive ...point of view...That would be identifying risks within your department, ... [with others] ...developing a strategy for programmes to mitigate those types of risk, and then making sure that they do [achieve] them, and [that] there is some form of monitoring." - *Technical Manager*

Category#3: Characteristics and requirements (qualifying all interactions):

Within Category#3, there appeared to be three main themes:

1. *Communication*, including (a) communication across all interfaces and between all parties; (b) courage/boldness in communicating the consequences of difficult choices;
2. *A team approach*, and understanding the whole system, including (a) trust and mutual support of different players; (b) competence of different players;
3. And the translation of these matters into the working of the bureaucracy, including: (a) exercise of authority, and fear of transgressing authority; (b) slowness to get an interview or decision.

Communication at all levels appears to be critical. Between officials in a technical department, an approach was described by the *Technical Manager* as follows:

"I am a firm believer in the fact that if more people know more, they are empowered to do more things, so I have a management committee meeting every week...[although] one week it is really abridged ...and every second week it would be a more full one, [with] progress [checked] on all of the actions that get listed, to make sure that things happen. [However], ... when a major issue arises that needs to be communicated, it is communicated immediately and that is usually verbal [or] e-mail or a combination. ... If I think something is really important, I will make sure that I see a person face-to-face, phone call, whatever, so that I know that the person has got the message..." - *Technical Manager*

On the communication between ward councillors and the community, the Social Consultant commented as follows:

[Paraphrased:] Communication of information about a project from the project managers back to the community is usually done through the ward councillors. If it is a large community, then the chain of people communicating this message might be say four people. In a smaller and younger area, one may well have a person from the community sitting in on the meeting between the project managers and ward councillors, so that the message is more direct - i.e. less of a "broken telephone" problem. - *Social Consultant*

So good communication is clearly a recurring theme. But more than simply good communication is the need for courage and boldness at all levels in communicating the true consequences of particular courses of action, and in taking difficult decisions. With respect to the decision-making, the *Councillor* made the following comments:

"Now we need to take a bold political decision..." - *Councillor*

"The Mayor might say: 'You know, we are playing with fire and might end up being very unpopular.' " - *Councillor*

With respect to pointing out the consequences of proposed decisions to politicians, the *Senior Manager* pointed out that there is a danger that an official may be "too scared" to do this:

"...Politicians aren't stupid, but sometimes they don't know". And further: "If [the politicians] are confronted with the right information, and [they engage with it], then they may be a bit less gung-ho." - *Senior Manager*

And again, the *Technical Consultant* gave a specific example where the responsible officials did not explain the full consequences of a proposed decision to the political decision-makers:

"I could not understand why [the officials] when they had the opportunity did not state the truth in terms of what the problem was and what was needed. So you have now launched [government] into saying something which is not achievable..." - *Technical Consultant*

More than communication, the *Councillor* went further to suggest that it required a co-ordinated effort as a team to make real progress:

"...the ability to work as a team...is about establishing relationships, about getting out of your own box for your work to be effective, but knowing which boxes have more impact in your life. But you don't wait for them, you go and ask them and in fact you develop protocols that makes it possible for you to do your work." - *Councillor*

And together with a team approach, the *Councillor* further suggested that it required people who understand how the whole system functions:

"...my understanding is that today...yes, you need people who specialise in a particular skill, in this case it could be water and sanitation systems. But you want people who understand in the context of local government how the entire system functions." - *Councillor*

The cumbersome nature of the bureaucracy was another recurring theme, and the difficulties posed by detailed decision-making being held by the Mayoral Committee:

"...with large municipalities you've got this bureaucracy. If you have got to have something passed, it has to go through probably the Mayor's office, and considering the size and scope of the [large municipality] that the Mayor is running, he is he is unable to meet to attend to those things, and the issue of time becomes critical...The bigger it gets, the more [bureaucratic] it gets." - *Social Consultant*

And again, describing the difficulty of access:

"In order to see a head of department or senior person to get a decision, one could be waiting for two weeks. You might want to have a one-on-one, but the structure of the organisation doesn't allow that. Your immediate supervisor or line manager may have that type of access, but you don't have that sort of access as a project manager on the ground". - *Social Consultant*

Interestingly, the view of the *Social Consultant* was that the problems of the bureaucracy did not differ much between larger (well capacitated) and smaller (less well capacitated) local authorities:

"I have had interactions with local government officials [in one of the poorer provinces of South Africa], but when I [went to one of the richer provinces], I kind of got a shock because you think...in a city they do things differently, but when you get inside... you think ... we are not as different there, because the principles are the same... You know, I thought things would run differently, but to my surprise, they are like your other municipalities, ... so for me, size didn't really matter" - *Social Consultant*

The difficulty of some of these procedures was well-described by the Social Consultant, who also alluded to the problem of saying uncomfortable things, with the example of an incident with a Presidential Imbizo:

"...the housing department ...has a whole series of activities that you need to do before you actually start building a house. [O]ne of these politicians once commented: 'I am not interested in all these other things that you are telling me. What I am interested in is I just want to build the house'. We were telling him [that] we [were] still waiting for this township establishment, and approval [for this and approval for that]. I can tell you, those ...take for ever. Probably if you are not within [the] housing sector, you wouldn't understand. [But that is why, say] they said they would build 200 houses and they have built only 4. But when you get the detail ...of these other processes that you need to satisfy...it's huge. The challenge, [the politicians say is that] we still need to have this [process, but] ...how can we speed [it] up ... [so that it] is not going to impact us [like this]. ...You don't go to the President and tell [him] about you not getting ... approval [for] township establishment, for instance.' - *Social Consultant*

What the *Social Consultant* also pointed out was that these procedures were strict, and that one was not at liberty to bypass them:

[Paraphrased:] If unforeseen circumstances arise on a contract that requires additional budget, officials on the ground may feel that the best option for the sake of continuity is to let the existing contractor continue with an increased budget. However, there may be different views in the Council. Council may prefer to have another contractor doing that, because they want to empower or involve new contractors. Resolving these different views on a contract can cause a lot of delays. Officials on the ground have been fired for breaking the Code of Conduct if they go ahead and increase the budget without approval from Council. Sometimes Council will support increasing the budget, and other times they won't. You don't know which it will be.....Because one is at the project level and one wants the project to succeed, one tries to make a plan to ensure that it succeeds. But with your senior officials or head of department, as much as they want the product, they have got these systems that they need to follow, and they have got to account for their actions if things go wrong. You can't say that your official did something that you were not aware of. You have got to take the rap. - *Social Consultant*

From this example, it appears that the decision-making authority is being held right at the top of the organisation, with very little delegation to officials lower down.

The bureaucracy appears cumbersome in itself. Nevertheless the situation appears to be exacerbated by the absence (or low representation) from the decision-making sections of the hierarchy of people with technical skills:

"...within that environment that I have described as a department [see Figure 2.10]... there are two [problems]: The people who know anything about project management are the ones at the lower end [of the hierarchy]. The ones...[at the top end of the hierarchy] don't know anything about this. So they are technically deficient ...and then from a project management point of view, they are again deficient...There is nothing you can do about the technical side of it, but you can resolve a few issues on the project management side."

- *Technical Consultant*



FIGURE 2.10:
INTERFACE BETWEEN POLICY/
DECISION-MAKERS AND TECHNICAL
PROFESSIONALS IN DEPARTMENTAL
HIERARCHY

"So we are sitting now with a person who is not going to believe what is essentially the only expert advice he has got... and he doesn't know how else to go about making that decision, or how to interrogate the information [that he is given]... That tension then on its own creates a longer loop in terms of how the decision is arrived at, because it has got to be vetted and revetted many times. And when that decision is finally made, because that distrust is still not out of the system, the decision that gets made tends to be on the conservative side." - *Technical Consultant*

There is also a link between competence and trust. Competence and trust need to go together. "...I think we are very fortunate in the councillor that we have with [municipal services] because [he] does understand service provision and [the] constraints of it. I think if you had somebody who didn't understand it, it would be quite difficult. On the one hand you can't take [him] for a ride and just tell him anything. On the other hand, [he supports] you if you come up with a good and reasonable answer." - *Technical Manager*

Linked to the issue of competence at different levels of the hierarchy, the issue of race was also raised by two of the interviewees - one white and one black. The matter is undoubtedly complex. Nevertheless, both indicated that it was problematic where matters of race overrode matters of experience in allocation of positions of authority.

2.5 Conclusions

1. There *is* a lot of information readily available in the sector on the provision of water services to meet developmental objectives (included in Appendix A). This information emphasises poor communities in which a range of factors other than purely technical factors are addressed.
2. What appears to be weak or missing is information on how to apply this information in context; and that context is the bureaucracy consisting of a combination of political and technical disciplines.
3. ***Developmental water services*** was defined as 'the provision of water services to meet developmental objectives, with an emphasis on poor communities, in which a range of factors other than purely technical factors are addressed'. A key finding of the study was the identification of a further major aspect of developmental water services as 'a combination of political and technical disciplines in a unified approach, consisting of:
 - (a) Implementation of services on the ground carried out by technical professionals (in different fields such as engineering, health, housing etc., often arranged institutionally into departments along those lines);
 - (b) decisions, trade-offs and resource allocations (within limited resources, to meet developmental objectives) carried out by politicians;and the institutionalisation of this, or translation into the bureaucracy'.
4. As to whether there is literature on these newly identified contextual aspects of developmental water services, the answer is that there is some literature on individual elements, such as:
 - (a) trade-offs;
 - (b) different disciplines (particularly political and technical/engineering);
 - (c) different disciplines asking different types of question;

- (d) formalisation of arrangements in the workings of the bureaucracy.
...but that it is more dispersed and limited than the technical literature, and is therefore not readily available and accessible to the water services community.
5. The in-depth interviews overwhelmingly supported the notion that developmental water services is 'a combination of political and technical disciplines in a unified approach, and the translation of this into the bureaucracy' (as described above). From the comments by interviewees on the context within which they operate, a *simple preliminary framework* was constructed to describe the key elements and characteristics of the workings of the bureaucracy as it applied to developmental water services. This framework consisted of two main *categories*, with a third category applying generally to both of them, and a number of sub-themes within each category:
 - (a) *Interactions between politicians and officials/technical professionals - nominally 'down the hierarchy' from politicians to officials - involve:* (i) translation or conversion from: policyto delivery, generalto specific, abstractto concrete, purposeto technique, and non-technical.... to technical; (ii) the bureaucratic aspect of this translation, namely delegation of authority (and reporting in reverse), and allocation of resources, specifically budget allocations (and reporting on budget expenditure in reverse).
 - (b) *The making of trade-offs and key decisions of principle, requiring prioritisation between different projects and different departments - nominally 'across the hierarchy' - involves:* (i) conflicting objectives, (ii) trade-offs and prioritisation within limited resources, (iii) risk and mitigation of risk.
 - (c) *General characteristics* applying to both of the above involve: (i) Communication, including communication across all interfaces and between all parties; courage/boldness in communicating the consequences of difficult choices; (ii) a team approach, and understanding the whole system, including trust and mutual support of different players, competence of different players; and (iii) the translation of these matters into the working of the bureaucracy, including: exercise of authority and fear of transgressing authority, slowness to get an interview or decision.
 6. This framework - together with the supporting evidence from the in-depth interviews - is a key output of the study, providing a preliminary description of the *contextual* elements and characteristics of developmental water services.
 7. Two other key observations were made in respect of the context:
 - (a) The *interfaces* between different groupings and disciplines (e.g. politicians, technical professionals, community) - and *communication across these interfaces* - are also identified as being critical.
 - (b) The major conclusion from observing institutional arrangements and decision-making processes is the *critical importance of the Mayoral Committee/Executive Mayor* in decision-making for developmental water services.
 8. In summary, it was the *contextual* aspects of developmental water services, consisting of 'a combination of political and technical disciplines in a unified approach, and the translation of this into the bureaucracy' which on the evidence of the in-depth interviews would appear to constitute the major challenge facing high-level technical professionals and decision-makers in the provision and sustainability of water services.

3 COMPETENCIES AND OTHER INDIVIDUAL CHARACTERISTICS

3.1 Introduction

While the previous chapter focused on the *knowledge/information* available on developmental water services and the *context* within which it is applied, this chapter focuses on *competencies* - and other characteristics of the individual - described as significant in water services provision in the literature and by those participating in interviews in the research.

A central tenet of our working definition of knowledge uptake is that knowledge must be visible and used in practice for it to be considered taken-up by an individual. Consequently, knowledge uptake is best considered and explored by considering and exploring those competencies that are observable in the decisions, discussions and actions of technical professionals and decision-makers. Focusing on competencies also allowed the participants in the study to focus on an observable set of competencies or attributes that they could identify, describe and evaluate. Knowledge uptake is far too theoretical a construct with which to approach people working in the field. In our discussions, they were far better able to comment on and find examples of competencies presented to them from the literature. This study is therefore *not* primarily about *how* the knowledge is taken up. Rather, the focus of the study is on the *knowledge taken up* and how it is demonstrated in practice in the form of competencies.

Competencies can be studied from two perspectives:

1. *Individual* competencies, which are competencies evident in the individual, and how these contribute to the effective completion of tasks (i.e. competencies that *exist*);
2. *Threshold* competencies (Peiro, 2001), which are the minimum competencies required by the actual job (competencies that *should exist*).

In this study - the first phase of research on competencies demonstrated by individuals in the water services sector - we do not make this distinction in our discussions. Participants identified and reported both threshold and individual competencies during interviews. Firstly, individual competencies were discussed in terms of particular knowledge, attributes and competencies individuals used in performing their work that made them successful in what they did. The participants also described threshold competencies that they considered significant to a position that were not always evident in those undertaking the work of the position. Secondly, a number of competencies evident in the literature were not considered particularly significant to the participants. These are then identified as threshold competencies but without any attention to the level of competence required. In summary, therefore, while the research did attempt to address the full range of competencies, it did not always distinguish clearly between the competencies that *existed* (individual competencies) and those that *should exist* (threshold competencies).

The international literature on competencies of personnel in the water services sector provided an initial understanding of what competencies may be required in the water services sector in South Africa as well as providing a starting point for discussions with high ranking technical professionals and decision-makers in the sector. The literature provided both a useful means of identifying competencies and establishing a starting point for discussions with the participants. Most of the English language literature available on water services provision has been produced

in North America, UK and Australia. In these nations civil engineers are the primary technical specialists and decision-makers. Consequently, much of the literature surveyed for this report has a technicist slant. It is however interesting to note that even when civil engineers are the primary practitioners in the water service provision the attention to 'soft skills' remains. Most of the substantial international reports focus on a full complement of competencies required by the practitioner.

Lastly, the competencies described in this chapter refer to developmental water services *as a whole*, rather than to particular disciplines or individuals within it. What is suggested is that particular disciplines or individuals may be stronger or weaker in particular competency areas, but that the full range of competencies should be covered by the sector as a whole.

3.2 Competencies

Clustering of competencies

The key competencies required of and demonstrated by technical water professionals and decision-makers have been organised into competency clusters at two levels (Peiro, 2001):

1. The first level distinguishes between methodical competence (MC) **(1)**¹ and social competence and competence of personage (SCCP) **(2)** (Peschges and Reindel, 1998). Methodical competence (MC) involves learned competence in the discipline or field. Social competence and competence of personage (SCCP) involves the capacity to work with various stakeholders in the context of work, and personal attributes that are necessary to more (or most) effectively complete the work at hand. Both methodical competence (MC) and social competence and competence of personage are underpinned by Judgement **(3)**.
2. The second level of clustering breaks down MC and SCCP into sub-clusters, thereby providing a deeper analysis and understanding of the competence required in water services provision. Methodical competence **(1)** is clustered into two sub-clusters, namely, academic competence **(1.1)** and practical competence **(1.2)**, which includes the ability to learn and use academic knowledge as a 'toolbox' of methods to complete a task. SCCP **(2)** includes the ability to manage or oversee projects, tasks or developments, and those interpersonal and intrapersonal qualities required in the complex social interaction involved in the many phases of undertaking tasks in water services provision. Consequently, SCCP **(2)** has been divided into three sub-clusters, namely, administrative **(2.1)**, interpersonal **(2.2)** and intrapersonal **(2.3)** competence.

Along with the important role of establishing a methodology in the study of competencies and knowledge uptake in the water services sector, the research provided some useful insights into the competencies required and demonstrated by the participants. Key competencies rather than *all* competencies, and those that provided interesting results, will be discussed at length with evidence in the report. Rather than address the key competencies in order of importance or learning chronology, the competencies are introduced in the clusters outlined above.

¹ Bold numbering in brackets - e.g. **(1)** - refers to numbering in Table 3.1: Competencies for Technical Professionals and decision-makers

A summary of the competencies has been produced for quick reference and may be found in Table 3.1. Table 3.1 has been formulated from the competency issues raised in the literature and revised using the comments of the interviewees.

Tables 3.2 and 3.3 provide a summary of the competencies required by technical professionals and decision-makers, as indicated by the interviewees, as well as a summary of the areas of concern expressed by the interviewees.

TABLE 3.1:
COMPETENCIES FOR TECHNICAL PROFESSIONALS AND DECISION-MAKERS

Methodical competence (1)

Academic (1.1)	Practical (1.2)
Active life-long learning (1.1.1) - accessing information - lifelong professional development - initiative to continue learning	Technical know-how and skills (1.2.1) - scientific method and analysis - knowledge of contemporary issues - materials and design knowledge
Knowledgeable analysis (1.1.2) - compare information or situations - interpret & analyse, recognising the relevance of, given information - evaluate the viability of solutions - plan provision of services	Numeracy (1.2.2) - understand technical information and the basic structures of an engineered system - perform basic calculations - interpret diagrammatic information (e.g. graphs) - visualise plans & product
Technical decision-making and problem solving (1.1.3) - analyse new situations - integrate and apply diverse fields of knowledge in practice - overcome obstacles - revise processes	Information (ICT) Skills (1.2.3) - software applications - macro writing - design tools - seek, store & retrieve info as needed

Social competence and competence of personage (2)

Administrative (2.1)	Intrapersonal (2.2)	Interpersonal (2.3)
Business sense (2.1.1) - understand business processes - estimate economic costs - project management - knowledge of legislation and public policy	Listening (2.2.1) - listen to others - synthesise different perspectives - observe interactions	Teamwork (2.3.1) - respect for others - productive working relationships - function on multi-disciplinary teams
Environmental awareness (2.1.2)	Creativity / Innovation (2.2.2) - original & alternative solutions - show initiative	People management and leadership (2.3.2)
Ethical (2.1.3) - show integrity - belong to professional societies - responsible to the profession - confidentiality	Adaptable (2.2.3) - anticipate and predict change - manage change - help others adapt	Working with stakeholders (2.3.3) - client focus - understand needs of clients - negotiation - work within socio-economic context
Time management (2.1.4) - establish time frames - maintain timelines - meet deadlines	Awareness of self in context (2.2.4) - motivation - designated responsibility - multiple demands - aware of potential problems	Communication (2.3.4) - language proficiency - AV presentations - comprehension and writing - oral communication - interpersonal communication

Judgement (3)

Judgement - Judgement is fundamental to methodological, social and personal competence and impacts in every decision and sphere of influence of the individual - Judgement includes the ability to evaluate information, isolate central issues in decisions, balance competing interests and check viability of decisions
--

TABLE 3.2:**COMPETENCIES REQUIRED BY TECHNICAL PROFESSIONALS AND DECISION-MAKERS, AS INDICATED BY INTERVIEWEES**

		Technical professional						Councillor					
		SM	TM	C	SC	TC	total	SM	TM	C	SC	TC	total
1	Engage in active professional development in the field	yes	2+	2		-1	3	0	2	-1	2	-1	2 c
2	Apply and integrate knowledge in real world situations	yes	2	2		-1	4	-1	2	0	1	-1	1 gc
3	Problem solving through evaluating and analysing situations	yes	2\$	-1		1	2 c	0	2	2	2	-1	5
4	Interpret engineering and graphical information, and perform basic calculations to check information provided	yes	2	2		2	6	-1	0	-1	0	0	- na
5	Able to work with necessary instruments and conduct or follow the creation of experiments	yes	0	2		2	4	0	0	-1	0	0	- na
6	Can use the software required at work	yes	2	2	#	2	6	0	0	-1	0	-1	- na
7	Shows a business sense by estimating costs and understanding the basics of business processes	yes	2	-1		1	2 c	-1	2	0	0	0	- na
8	Knows and understands the basics of the legislation and public policy in the field	yes	-1	2		-1	0 gc	-1	2	2	2	-1	4
9	Applies sound judgment in evaluating information and making decisions	yes	1	2		1	4	-1	2	-1	1	-1	0 gc
10	Shows integrity and professional responsibility	yes	2	2	#	1	5	-1	2	1	1	1	4 c?
11	Is able to estimate the time to complete a project and works to reasonable deadlines	yes	2	2	#	2	6	0	2	-1	0	-1	0 gc
12	Is aware of environmental issues when working in the field	yes	2	2		-1	3	-1	0	2	2	-1	2 c
13	Listens to other perspectives with attention	0	1	-1	#	1	1 c	2	2	1	1	2	8
14	Thinks creatively to produce original solutions and innovations	yes	1	-1		-1	-1 gc	1	0	1	1	2	5
15	Can adapt to new situations and manages change well	yes	2	-1	#	-1	0 gc	2	2	2	-1	2	7
16	Is motivated and responsible in work contexts	yes	2	2		1	5	0	2	2	1	0	5
17	Manages multiple demands and is aware of progress in projects	yes	2	2		1	5	0	2	1	2	1	6
18	Demonstrates leadership and manages people well	yes	2	2		1	5	0	2	2	1	2	7
19	Works effectively in a team	yes	2	2		-1	3	0	2	2	1	-1	4
20	Is attentive to other stakeholders (such as clients) within a socio-economic context	yes	2	2		-1	3	2	2	1	1	-1	5
21	Communicates well with other people in discussion	yes	2	-1	#	-1	0 gc	2	2	1	2	-1	6
22	Communicates well in writing	yes	-1	2		-1	0 gc	-1	0	1	0	-1	-1 gc

KEY:

- Interviewees: SM = Senior Manager
TM = Technical Manager
C = Councillor
SC = Social Consultant
TC = Technical Consultant
- Coding for classification: -1 = Required, but not very good at it
0 = Not a required skill
+ = "There is very little time for reading. The only way to keep abreast of the field is really through workshops and conferences" (TM)
\$ = "Considered very important" (TM)
1 = Some good some bad
2 = Required and people are generally good at it

= "Concern expressed" (SC)

SC commented on project managers rather than technical professionals. He thought they were generally good at the competencies listed above, but did express some concern in particular areas.

3. Summary classification: For each competency, the coding values are simply added up to give a total score e.g. 2+2-1 = 3 and a classification (c = area of concern or gc = area of grave concern) assigned, which was based on: (a) total score (for Technical professional: gc = -1 to 0; c = 1 to 2; for Councillor: gc = -1 to 1; c = 2 to 4); (b) number of -1's (Required but not very good at it), as well as other comments of concern expressed in the further discussion.

TABLE 3.3:
AREAS OF CONCERN AND GRAVE CONCERN EXPRESSED BY INTERVIEWEES

Areas of concern (c)		Areas of grave concern (gc)	
Technical professional:		Technical professional:	
3	Problem solving through evaluating and analysing situation [= Technical decision-making & problem solving (1.1.3)]	8	Knows and understands the basics of legislation and public policy in the field [= Business sense (2.1.1)]
7	Shows business sense by estimating costs and understanding the basics of business processes [= Business sense (2.1.1)]	14	Thinks creatively to produce original solutions and innovations [= Creativity / Innovation (2.2.2)]
13	Listens to other perspectives with attention [= Listening (2.2.1)]	15	Can adapt to new situations and manages change well [= Adaptable (2.2.3)]
		21	Communicates well with other people in discussion [= Communication (2.3.4)]
		22	Communicates well in writing [= Communication (2.3.4)]
Councillor:		Councillor:	
1	Engage in active professional development in the field [= Active life-long learning (1.1.1)]	2	Apply and integrate knowledge in real work situations [= Knowledgeable analysis (1.1.2)]
10	Shows integrity and professional responsibility [= Ethical (2.1.3)]	9	Applies sound judgement in evaluating information and making decisions [= Judgement (3)]
12	Is aware of environmental issues when working in the field [= Environmental awareness (2.1.2)]	11	Is able to estimate the time to complete a project and works to reasonable deadlines [= Time management (2.1.4)]
		22	Communicates well in writing [= Communication (2.3.4)]

NOTE:

Competency statements from Table 3.2 (e.g. 1 'Engage in active professional development in the field') are followed by the equivalent competency categories from Table 3.1 in square brackets (e.g. [= Active life-long learning (1.1.1)])

In the more detailed discussions of the competencies which follow, two types of evidence for the classes of competence are used: Firstly, evidence of competence as demonstrated by the interviewees. Secondly, competencies that the interviewees raised in discussion as they pertain to the performance of people working in the water and sanitation sector.

*Methodical Competence (1)*²

In the development of the research proposal, interpretation of the literature, formulation of the interview questions and in the analysis of the interview transcripts, the researchers frequently discussed the classification and role of technical knowledge in the sector. Rather than focus directly on the technical knowledge, this study has focused on the generic competencies that underpin - and are common to - a range of technical knowledge areas. It is these generic competencies that are addressed under the heading of 'Methodical competence'. *Methodological competence (1)* is influenced by the application of *academic knowledge (1.1)* and *practical knowledge (1.2)*. *Academic knowledge* is demonstrated by active life-long learning (1.1.1) on the part of individuals, knowledgeable analysis (1.1.2) and a competence in technical decision-making and problem solving (1.1.3). *Practical knowledge* is demonstrated by technical know-how in the field (1.2.1), basic numeracy and engineering numeracy (1.2.2), and information (ICT) skills (1.2.3).

In this investigation we have chosen to focus on three primary categories of knowledge and the accompanying competencies that are significant in the water sector. All three of these primary categories fall under the Methodical Competence category (1), but fall into different sub-clusters: numeracy into the practical category (1.2), and knowledgeable analysis and technical decision-making and problem solving into the academic category (1.1). Each category will be introduced here and then more fully elaborated under its own heading.

Firstly, *numeracy (1.2.2)* involves the basic ability to understand information, data, graphs and engineered systems. Numeracy requires a more general competence that most people would acquire at school or through life experience. It is absolutely essential that all stakeholders and role-players in the water sector demonstrate competence in numeracy.

Secondly, *knowledgeable analysis (1.1.2)* involves the ability to not just understand but interpret and analyse information and use the information in decision-making. All technical professionals should be highly competent in knowledgeable analysis and the greater the level of competence demonstrated by decision-makers the better.

Thirdly, *technical decision-making and problem solving (1.1.3)* involves the ability to formulate problems and generate solutions in new and complex situations. This requires a strong academic knowledge base, high order reasoning and the ability to integrate diverse fields of knowledge in real and often complex contexts.

It is clear that the three categories are hierarchical. Furthermore, as evidenced by the participants' interview comments, the need for these competencies is related to the role a person plays in the

²

Bold numbering in brackets - e.g. (1) - refers to numbering in Table 3.1: Competencies for Technical Professionals and decision-makers

sector.

Academic Competence (1.1)

Active life-long learning (1.1.1)

A number of authors recognised the importance of life-long learning in developing fields such as water services provision (El-Raghy, 1999; Nerz and Weiner, 2001; ASCE, 2004). Of central significance was the capacity and attitude for self-learning. Practitioners and decision-makers must have the capacity to actively seek new information, research reports and developments in the field. This requires the ability to access, understand and assimilate new information in the field.

Life-long learning may take on various forms including additional formal education, continuing education, professional practice experience, active involvement in professional societies, community service, coaching, mentoring, and other learning and growth activities (ASCE, 2004). Seldom does continuing professional development occur at the behest of others resulting in a substantial need for initiative on the part of the individual. In effect the practitioner tries to maintain competence to practice and to increase professional proficiency and expertise (Kalanidhi, 2001).

Not all information or skills can be acquired during the formal education process. Davis et al. (2003) differentiate between competence that must or should be available to the individual at the beginning of their technical career and those competencies that are best developed through experience over time and should really not be 'taught' in a degree programme. Although much can be learned and competence - particularly social competence - developed 'on-the-job', there is clearly a need for more formal continuing professional development to ensure a growing sophistication in understanding and applying the most recent theoretical ideas.

In the research only the Technical Manager gave any indication of engaging in continuing professional development. He claimed that:

"As much as I would like to have the time to read a whole lot of journals and that I just don't. I might read an Executive Summary - what I will do is I will go to a conference or a seminar where somebody presents to me what the findings are." - *Technical Manager*

Implicit in his claim is that time does not allow for the type of reading required of comprehensive journal papers. He does however try to access the key points or ideas through reading an executive summary or attending a presentation. He also claimed that within the technical divisions of his department:

"there is intensive type of training, in-house training, on-the-job type of training, and in particular making sure that the process managers who control a lot of the processes understand if I do this, what is the consequence on that." - *Technical Manager*

This comment and the lack of mention of continued learning by the other participants in the research suggests that continuing professional development is structured within the sector for middle-level managers, particularly those making technical decisions. However high-level

management and decision-makers find little time or show little inclination and have few professional development expectations placed on them (although this is likely to change with the new Engineering Council of South Africa (ECSA) Continuing Professional Development (CPD) requirements for ongoing professional registration).

Knowledgeable analysis (1.1.2)

Knowledgeable analysis involves the ability to not just understand but interpret and analyse information and use the information in decision-making. Therefore in the USA the professional association for civil engineers claims: "A technical core of knowledge and breadth of coverage in mathematics, science and civil engineering topics is stressed in this outcome. Underlying the professional role of the civil engineer as the master integrator [through comparison of ideas and situations] and technical leader" (ASCE, 2004, p.24-29)...is the following:

This is a broad categorisation that includes the ability to:

1. compare information looking for contradictions or reinforcement of ideas;
2. determine the relevance of given information to a situation;
3. interpret and analyse information seeking those aspects that are salient or central to the situation and demonstrating an understanding of the consequences of acting on the information;
4. evaluate the viability of given solutions and identify potential pitfalls; and - consequently,
5. plan water and sanitation provision over time and space.

In essence knowledgeable analysis requires competence in working with other peoples' solutions rather than finding your own, and remains convergent thinking. (One of the difficulties, though, of being a 'master integrator' is that it requires the ability to integrate technical and non-technical topics, for which civil engineers may not always be well prepared. The topic is further discussed at the end of the section on Technical decision-making and problem solving (1.1.3)).

In the first-world literature studied for this research, knowledgeable analysis is seldom discussed but is rather subjugated to competence in higher order, more divergent thinking required in problem solving and practical applications. The tension that exists in developmental water services provision in the developing world is between the levels of competence required for technical professionals and decision-makers in the core technical competencies of numeracy, knowledgeable analysis and technical decision-making and problem solving. The evidence below demonstrates a general requirement that all those involved in water services provision should at least be numerically competent. It is also argued by most of the interviewees that problem solving and applications is primarily the domain of technical professionals. The technical professional is frequently in middle-level or regional management. The level of knowledgeable analysis expected of decision-makers varied among the interviewees. The capacity of decision-makers to undertake knowledgeable analysis within the water service provision sector was brought into question. Some interviewees suggested that this was not a requirement for decision-making while others found it a useful competence in their own decision-making and a frustration when dealing with decision-makers who were limited in their ability to analyse information with an appropriate knowledge base.

As illustrated by the Technical Manager, management often assumes that a degree in engineering is concomitant with competence in knowledgeable analysis:

"My [reticulation network] manager for example has a civil engineering degree and that would generally be the minimum requirement with a certain number of years relevant experience." - *Technical Manager*

The validity of such assumptions remains unclear. Of greater significance is the number of people in the water sector, who do not have an engineering degree, but can demonstrate competence in knowledgeable analysis.

The Technical Manager expresses the personal value he finds in having a strong technical background but does not see this as a necessity. Indeed he argues that the value of his technical background is in understanding what the technical experts present to him, thus his ability to engage in knowledgeable analysis rather than problem solving.

"I partake of that [technical discussions] because I'm a civil engineer, it's my background and I find it interesting. I don't think for my position, however that that is necessary." - *Technical Manager*

"I am very dependent on my [treatment works] people to help me. I can very easily understand when they say this, that and what we must do, and one can make a decision on that but I'm not going to be the one in all honesty who is going to be able to say, you know what, you've got to up this and down that and the process will come right." - *Technical Manager*

The quote about the Technical Manager being 'dependent on his [treatment works] people' is a good example of knowledgeable analysis.

The participants provided varying opinions on the value of knowledgeable analysis as a competence of high-level decision-makers. The Technical Manager suggested that having management who are sufficiently competent in a technical field is a nice-to-have but that having management who can work with people and motivate staff is probably more important.

"It's nice if you are a technical expert there [in management] as well. If you are not in your field, for example, my [bulk wastewater] manager is probably actually a networks orientated specialist where he's coming from." - *Technical Manager*

The Technical Consultant argued that without knowledge and understanding - that is knowledgeable analysis - councillors are not really in a position to make decisions.

"And so how we went together to the politicians because in the end these are the councillors who will say yes or no. And they cannot say yes or no to something they are not understanding." - *Technical Consultant*

The Councillor suggested that at times technical capacity might actually be a hindrance to decision-making because the significance of political and social factors in decision-making can sometimes be neglected by experts in favour of technical factors. This comment also suggests that the 'master integrator' might need to be a professional with good planning skills (rather than merely hard engineering skills).

"So to me it became clear that your technical people, their ability to deal both with the political system, and the community is very important, because if it is a problem that only you understand as an engineer, you are going to be a very frustrated person." - *Councillor*

The Councillor did however recognise that a lack of knowledgeable analysis as demonstrated in planning was acute within his local authority. Planning is a function of decision-makers rather than technical professionals and requires a number of competencies including knowledgeable analysis.

"Our planning capacity in my view is almost non-existent, you know at best you are battling to, because even in the maintenance you are relying heavily on sub-contractors." - *Councillor*

The Technical Consultant found that a lack of technical capacity and in particular knowledgeable analysis in the decision-making process hampers and frustrates planning and implementation.

"The people at the Deputy Director or Director levels are not coming from an engineering background. These are people who are employed via other processes. So firstly, they just simply don't understand, they have no knowledge of these other issues that they are on about, the planning or whatever those things are. Then these are the people who then inform the policy positions. They [decision-makers] don't have the technical know-how or knowledge that he possesses." - *Technical Consultant*

The Technical Manager suggested that section/divisional leadership in the technical branches of the water department/utility should 'know something' or have a 'good understanding' of water provision and sanitation. He claims that of greater significance is that the core technical competencies are available to management in each division and that middle level technical management demonstrate strong competence in knowledgeable analysis. Ideally, middle level technical management should be able to demonstrate competence in 'technical problem solving' and 'management'. If they don't have those competencies, then they should be able to demonstrate competence in 'knowledgeable analysis' and 'management', supported by 'technical problem solving' competence available somewhere within the organisation. If these combinations of competency are *not* available, then there is likely to be a problem in the organisation.

"I don't think the [high-level manager] needs to be the technical trouble-shooter but he needs to be able to know who can give me the answer or can give me the five answers from which I can then combine what the most sensible answer is." - *Technical Manager*

"So you must just make sure that within your [section/division] that you have those core competencies. It would be nice if everybody could have it exactly but it doesn't work that way." - *Technical Manager*

In addition to the comments made by the interviewees, Tables 3.2 and 3.3 illustrate the broader concerns of the interviewees that decision-makers do not generally demonstrate knowledgeable analysis as a competence. The ability to understand information and integrate the information into decision-making in real world settings was portrayed by participants as an area of grave concern.

The researchers conclude from these remarks that senior technical leadership should demonstrate sufficient knowledge to be able to undertake knowledgeable analysis of information provided to them but do not require competence in technical problem solving or application of knowledge in divergent and new situations.

Technical decision-making and problem solving (1.1.3)

Problem solving is considered one of the six most significant competencies required by employers in the water service sector (Lee, 2003). The encounter with a new situation with limited direct application from previous experience requires a return to applying academic knowledge in a problem solving context. Problem solving may involve the analysis of the situation, overcoming unforeseen obstacles, evaluating alternative solutions (ASCE, 2004), and reflecting on and / or revising previous or ineffective solutions. In addition to problem solving the art of problem posing or formulation is also an instrumental aspect of problem solving (Lee, 2003). Problem posing has significant links to creativity and innovation outlined in the SCCP section below.

The 'information literate person' is someone who has learned how to learn (Nerz and Weiner, 2001). "Learning is a process that culminates in the ability:

- to ask the right questions and frame good problems;
- to acquire information and evaluate sources of information;
- to critically investigate and solve problems;
- to make choices among many alternatives;
- to explain concepts to others (both verbally and in writing), and
- to generalize to new situations."

As a starting point applying knowledge in a complex real situation requires that the practitioner fully understand learned mathematical, scientific and life sciences knowledge (Davis et al., 2003; ASCE, 2004). Besides the capacity to solve or even pose a problem the ability to evaluate a resource's relevancy, accuracy and authority is required of technical specialists and decision-makers in the provision of water services to communities. Sadly young practitioners' ability to evaluate information is minimal at best. This is problematic given the ever-increasing amounts of information made available via the World Wide Web. It is very easy either to become inundated with information or to find nothing using a simple keyword search on a web search engine (Nerz and Weiner, 2001).

Graduates' limited knowledge of the design process and development phase is one of the three primary areas of concern of the American Society of Civil Engineers (ASCE, 2004). Top technical experts are expected to operate at this level of expertise. The growth of this competence begins in formal tertiary education, develops through mentoring and experience, and should as a way of life continue throughout the person's career. A breakdown in any one of these growth factors will leave the person limited in problem solving and technical decision-making.

For example, limited decision-making has fallout in even simple activities like a clear plan for a developmental project:

"There are pressures to deliver, that in the process you compromise some to the crucial things that you are supposed to be doing, for instance I will see a project close to implementation but it does not even have a plan." - *Social Consultant*

Intrapersonal factors and the context in which the person is operating also significantly influence competence in technical decision-making. For example, poor judgment may limit decision-making, a lack of innovation may constrain problem solving, and an inability to adapt may result in suitable alternative strategies being missed or revision of ideas being neglected. A context where this technical competence is ignored or relegated to insignificant will limit the quality of the decisions made and may overlook significant issues in the problem solving process. For example, the councillor indicates that at present the technical water services people do not contribute to the decision about where a township is established.

"Remember again as a water and sanitation person you are not the guy who decides what townships gets established." - *Councillor*

High-level technical decision-making and problem solving cannot take place in a vacuum. The problems, solutions and decisions must be communicated effectively, must involve buy-in from stakeholders and must account for a number of social, political and economic constraints. Put differently, this suggests that convergent problems are in fact embedded in a divergent context.

At this point it is useful to comment further on convergent/divergent thinking: There are really two different kinds of divergent thinking, that can be confused with one another: (a) divergent problem solving as in technical engineering design (in which the divergent problem is generally converted into a convergent problem in order to solve it): These problems are normally resolved by the exercise of judgement, together with the application of the technique of satisfying certain minimum technical requirements, and then optimising the solution for minimum cost - which effectively converts the problem into a convergent one; and (b) true divergent problem solving, requiring major strategic trade-offs to be made, and usually carried out by politicians. (See also Figure 2.2: Different types of question)

All these additional personal and social competencies that must accompany high quality decision-making and problem solving further add to the difficulty of people involved in the process, and further exacerbate the shortages of competent people.

Practical Competencies (1.2)

Although these competencies may be part of formal tertiary education they are most frequently developed as byproducts of schooling and tertiary education.

Technical know-how and skills (1.2.1)

Hands-on experience through laboratory experimentation and computer simulation is considered significant in the development of basic numeracy skills and appreciation of the physical laws involved in 'engineering sciences' (El-Raghy, 1999; ASCE, 2004).

Technical competence including understanding the scientific method is required of the practitioner (Davis et. al., 2003). An understanding of scientific method includes knowing how

to undertake experimentation in the field and knowledge of the instrumentation used in the field. Civil engineers frequently design and conduct field and laboratory studies, gather data, create numerical and other models, and then analyse and interpret the results (ASCE, 2004).

Practitioners should begin their careers with the capacity to undertake hands-on experimentation, field and laboratory work. Although this should be learned during high school it has far too frequently not been suitably developed by technical practitioners in various engineering endeavours, including water services (El-Raghy, 1999).

In this research the participants, including the Technical Manager, saw very little significance for technical and instrumental know-how in problem solving and decision-making. This level of competence was regarded as a responsibility and requirement of middle to low level regional or district management.

" (reading a question) 'Able to work with necessary instruments and conduct ...?' I don't see that as a must but chances are they [middle management] can because they probably have come up through the ranks but can use all of the instruments but it's not necessary for him nowadays to use it at all." - *Technical Manager*

From an educational point of view, there may, however, be a misunderstanding over why engineering students need to do laboratory work: The reason for including laboratory work in the education of engineers may have more to do with *learning style* (in that many of them are sensing rather than intuitive learners, and therefore benefit from getting their hands dirty) rather than that laboratory experimentation is a particular *required skill*. In other words, laboratory experimentation may be essential for the students to understand the theory properly. (See Section 3.3: 'Further individual characteristics: Learning style' which addresses the topic, although not specifically the topic of sensing versus intuitive learners).

Levels of research and data collection within the water sector of local authorities appear to be minimal and insignificant. Lack of data generally also points to poor technical decision-making and problem solving. Good - i.e. appropriate - data collection accompanies good problem solving.

"We did not have data on all sorts of things. It was sitting in all sorts of consultants' offices." - *Senior Manager*

"I am not convinced if there is enough work done in terms of just research and development. I am not a technical person, but ..." - *Councillor*

Research involves advancement in understanding in contrast to standardized procedures. There is a big difference in approach between the two. Partly in response to low skills levels, the approach followed by government appears to have been to establish standardized procedures. This approach is effective in achieving stability and short-term results, but counter-productive when innovation and change are required to meet new challenges. It appears that research and development work is done by consultants, through funded agencies, universities and imported from abroad rather than undertaken in local authorities. The potential for training in and understanding of research processes and instrumentation to act as a basis from which to develop knowledgeable analysis or engineering numeracy appears not to have been sufficiently appreciated by local government.

Numeracy (1.2.2)

This may be the singularly most important methodological competence for those involved in developmental water services provision in South Africa. This competence is fundamental to communication between decision-makers, technical water professional and stakeholders.

Noss and Kent (2002) aptly describe the role of numeracy in the interface between technical professional and decision-maker:

"the specialist took on the task of carrying out whatever [advanced] statistics was needed in order to give us some figures for design.... although the complicated maths was out of the range of my boss or me, once the specialist had worked it out then it was within the range of us to understand what he had done at some level, to be able to use the results of it."

Numeracy required in developmental water services provision is characterised by a number of specific competencies. Firstly, the ability to represent information graphically and interpret graphical information is fundamental in the field of water services provision and construction (El-Raghy, 1999). Graphs are a succinct way to summarise and represent information, capturing a quantifiable situation and presenting it in a way that numerate people can use to quickly distil the essence of the situation. Most of the information presented to decision-making committees and individuals by technical professionals is done in graphical form. Secondly, numerate people are able to perform basic calculations to check information presented to them. For example, they can compare absolute increase and decrease with percentage increase or decrease. Thirdly, numerate people are able to visualise what the product of drawn plans or models may look like. Visualising structures and objects from a diagram is a valuable but sadly not universal competence. Lastly, in developmental water services provision numeracy must include the capacity to understand simple technical information and the basic structures of an engineered system. For example, a numerate person understands the basics of water flow in a reservoir or sanitation system. Without this basic numeracy, communication between technical professionals and decision-makers who are not educated in the technical aspects of the water and sanitation processes is virtually impossible.

Although the attributes of numeracy appear simple and obvious there are many people in South Africa, including decision-makers in water services provision who are not numerate. This complicates communication, hinders mechanisms of project evaluation and accountability, and severely limits decision-making.

The lack of competence in quantitative situations amongst decision-makers was argued by a number of the participants in the research. In particular, the participants identified an inability to understand quantitative information and simple technical structures as significant constraints in the process of making decisions and communicating with decision-makers.

"... frustrated with the councillors, and more the [local authority], the officials that are serving the councillors seemed unable to process any information you gave them." - *Senior Manager*

"I am saying for me it is just the skill and the knowledge that at times probably most of

them, they [decision-makers] are in these positions and at times they don't have the background in terms of the technical know-how of the position." - *Social Consultant*

"Within the other areas of the [local authority], I think we have people there who are learning and some people who are quite capable and then I think there are other people sometimes who don't quite always understand." - *Technical Manager*

"They simply cannot understand anything and everything to do with engineering works. So issue number one, when you propose, ... they couldn't understand anything and everything and you really had to go through this." - *Technical Consultant*

Interestingly the Technical Manager was impressed with the numeracy of the Councillor whose position involved oversight of the water and sanitation services in the local authority. The Councillor, by contrast, was concerned about the capacity of technical people to communicate technical information and results to him. Our evaluation of these statements suggests that although the Councillor demonstrated competence in numeracy he became insecure when dealing with more complex information and this is part of the reason he comments on others' ability to explain technical information.

"I must say I think we are very fortunate in the Councillor we have with the [particular service] because he does understand service provision and constraints of it." - *Technical Manager*

"My own limited experience is that dealing with technical people they need to be able to explain those things to you." - *Councillor*

During the interview each participant demonstrated, in his own way that he was numerate. To further elaborate on quantitative abilities as characteristic of numeracy, examples of four participants demonstrating numeracy are presented below.

"Unless you absolutely had to be at a meeting the next day, rather go a day earlier if you had to go overseas, which was seldom, go a day earlier [rather than fly business class], and spend a day's rest and recuperation and it would cost you R10,000 less on the flight and R1,000 extra on the hotel." - *Senior Manager*

"But how do you go about doing that, who is poor, you know it is not an easy question. If you follow the national treasury, when they talk about these poor, they put in a figure like you know so much 1200 or 1400. The root of the matter is that pensions have been increased to R780, so if you have two pensioners who earn R780 all of a sudden they are no longer poor." - *Councillor*

"Balanced scorecards would include the things like reduction targets for waste for water, increased targets for level of service provision, targets for BEE percentages and procurement, targets for response times to sewer blockages, to burst water mains, whatever the case might be." - *Technical Manager*

"If I've got 10 households that are drawing water from there. So they all go and draw 50 litres on the first day and so on and before Wednesday the 6000 has been drawn. These

people then move to the next higher level of paying of the tariff but these people, none of them has drawn 6000 for himself." - *Technical Consultant*

Similarly the Councillor demonstrates his competence in technical knowledge and engineering numeracy with the following remark:

"You buy newspaper, you read it, it ends up in the toilet that is what you are going too use there. But because it is not water-soluble it blocks the system. You have then all of the sewer spillage everywhere; it gets into your storm water; it ends up in the river system and all sorts of other complications and stuff." - *Councillor*

Although the evidence demonstrates high levels of numeracy in the participants, their comments suggest that similar levels of numeracy are lacking in the political and managerial decision-makers in the water services sector. The degree and breadth of a lack of numeracy is not evident from the research. However the research raises the issue and the literature illustrates how significant competence in quantitative numeracy and engineering numeracy is to the process of service delivery. Our concern is that levels of innumeracy are high and potentially widespread. This would have a significant impact on the quality and sustainability of water services provision. Furthermore, there seems to be no mechanism at present for ensuring that all stakeholders and role-players in the water sector demonstrate competence in numeracy.

Information Skills (1.2.3)

The use of information technology and contemporary tools is required (Davis et al., 2003; DEBS Project Team, 2001). Graduates' understanding of the role of technology in their professional work is one of the three primary areas of concern of the American Society of Civil Engineers (ASCE, 2004).

Nerz and Weiner (2001) recognise information skills as significant in the 21st Century. Their notions of information skills exceed the idea of ICT skills, also including higher order competencies of personal information management, appraisal and judgment. Decision-makers and technical specialists must understand the complexities of information management as finding information has become easier and more immediate giving young practitioners a false sense of security in information that has not be processed or fully evaluated.

In addition to the interviews, participants in the study completed a brief Likeart scale response form on a number of questions related to the methodological competence of the technical professionals and the decision-makers (Table 3.2 and 3.3). A broad (but not grave) concern was expressed about the methodological competence of the technical professionals as it relates to their ability to fully evaluate situations when problem solving a problem within a given task. Greater concern was expressed about the councillors and decision-makers' desire to engage in professional development and their ability to understand information presented to them.

Councillors' levels of numeracy and their capacity to engage in knowledgeable analysis is an area requiring further research. Two aspects of these methodological competencies that require study are (a) how widespread this lack of competence extends across councillors and councils, and, (b) suitable ways of improving these competencies.

Social Competencies and Competencies of Personage (2)

Administrative (2.1)

Administrative competence includes a variety of competencies often developed in MBA programmes, but which can also be developed through mentoring and experience. All administrative competencies are highly influenced by intrapersonal and interpersonal competence, but have been isolated for discussion because these competencies go beyond competence of personage. Sound judgment is a cornerstone of administrative competence. Beside the running of administrative functions within an organisation our discussions also apply to project planning and management.

Business sense (2.1.1)

Estimating and controlling costs is considered one of the six most significant competencies required by employers (Lee, 2003; Davis et. al., 2003; ASCE, 2004). Understanding business factors that drive the economic process of service provision is fundamental to decision-making, implementation and project management. Graduates' business sense and management is one of the three primary areas of concern of the American Society of Civil Engineers (ASCE, 2004).

A key aspect of good business sense in the public sector includes the capacity of technical practitioners to understand the basics of the legal implications of their actions, public policy and financial mechanisms in both the public and private sectors (ASCE, 2004).

Having a good business sense was possibly the single most significant competence evident in the comments of the participants. A good business sense included the following attributes:

- (1) *Being aware of strategic decisions and having a comprehensive view of the issues at stake in decision-making.*

Forward planning and strategic decision-making is a complex process that by all accounts is not always well developed. A central issue in strategic decision-making and forward planning is attention to sustainability. The participants highlighted a number of the factors influencing sustainability.

"... if these services are to be, sustainable we need forward planning, [for] the evolution of the city. ... Our planning capacity in my view is almost non-existent." - *Councillor*

"On the one hand you would want services to be delivered to an acceptable standard to all residents, but on the other hand you are thinking as a shareholder in what ever that they do they want a return on their investment, you always have a tension, you must be financially sustainable." - *Councillor*

"... if we roll out a full waterborne sanitation this is the typical cost, this is going to cost me money. This is the cost of the household which you need to recover as a municipality and at the moment these are your debts which you are unable to recover as a result of this" - *Technical Consultant*

"In particular there would be certain strategic directions that you might have set, or would have set in any event for your department at some time. ... So I mean one of the type of things is to look at is in terms of monitoring whether we are achieving there and when we aren't achieving [them]." - *Technical Manager*

Strategic decision-making with a comprehensive perspective requires extensive communication and listening to stakeholders, collaborating with governmental departments and specialists in the field of water services provision.

"... so you had a problem of understanding and a problem of communicating between the parties of what was to be done and what was even worse was this Department had taken a position without taking on board the other implementing departments, and without looking at how we could synergise all the other efforts." - *Technical Consultant*

The context of water service provision is a complex one. It is unfortunately not sufficient for water services to act holistically but project managers, other governmental departments and water suppliers must also function in a holistic manner.

(2) *Developing financial budgets and working within budgetary constraints*

The ability to conduct a budgetary process, develop a fiscally sound budget and manage the budget while dealing with competing interests is a significant competence. Setting up a budget appears to be the most significant fiscal activity. As the technical manager explains the process of setting up a budget provides the tools necessary for managing the budget and competing interests within the budget.

"You fundamentally understand because when you don't fundamentally understand how you set up that budget in the first place, when things go wrong and your budgets start overrunning, you are clueless as to what is happening." - *Technical manager*

One underlying aspect of undertaking a budgetary process is understanding how far money goes. The project consultant was asked to evaluate a budget and planned spending regime for a particular programme. He discovered that the budget was significantly under-funded.

"That year the budget for this programme was R[xx]-million. So I took a look at it and said what can you do for R[xx]-million? I then came to the conclusion not much, you can't even service one informal settlement." - *Technical Consultant*

A budget is not just a fiscal process but, as the Councillor so aptly states, also a demonstration of a local authority's priorities. Possibly the most challenging aspect of establishing a budget is the judgments that must be made in the appropriation of funding.

"How you allocate resources, in this case, take the budget as a reflection of your priorities, and those priorities would have as a base the inputs from various communities, be it the need for roads, for water, for parks, for schools, for clinics, libraries, primary healthcare, everything." - *Councillor*

(3) *Understanding the role of politics in the business life of parastatals and government departments*

The technical professionals and, more so, the decision-makers operate within the politics of government departments. Operating within this context has both positive and negative consequences. One significant consequence is the fear potential retribution engenders in people operating within the system.

"You cannot de-bureaucratise but you can de-logjam to a large extent, and then the law is over complicated in this love for government. People are scared of, you are going to transgress this or transgress that." - *Senior Manager*

This fear of blame and the consequences for decisions made can be debilitating to individuals and inhibiting to growth and development in water service provision. It appears that context constrains the more complex competencies of problem solving, decision-making and judgment.

(4) *Understanding public policy*

A national policy on water services has been created and must be implemented by local authorities. In addition to understanding national and provincial public policy, water and other services must form coherent internal and local policies that are workable in the local communities and adhere to national expectations. This can be particularly arduous when national government sets unrealistic or very demanding goals.

"... a lot of time is spent on that whole plan, and trying to understand the legislation, and trying to make your own policy. - *Senior Manager*

"Now if we were to talk a bit about some of the strategic goals that I think have been set nationally, there are very stringent goals that have been set, ..." - *Councillor*

"Then you come to the politicians, who are supposed to see that the Constitution is translated into tangible things. Now you set your targets, you probably set the targets start of the year from the Presidents speech to say this is what we need to do for this financial year, and they translate those into programmes that they want to implement." - *Social Consultant*

In addition to the remarks made in the interview, the results from the score sheet (Table 3.2 and 3.3) suggest that the technical professionals' knowledge of public policy and legislation is an area of serious concern. This lack of knowledge impacts both the technical professionals' ability to adhere to the guidelines and policies as well as limits their capacity to interact with decision-makers.

(5) *Managing practical operational aspects of water services provision*

In addition to working strategically within public policy frameworks management and leadership within the water service sector must also be able to work operationally within budgetary constraints and endeavour to motivate and manage people within the organisation.

Strategic plans and a solid budget are voided if the senior managers and decision-makers are unable to translate the plans into a feasible, workable and achievable set of actions within the local authority.

"Because you as much as you get their [policy] statements, you need to translate that into a workable policy within the municipality, you know translating that and planning around that to say how you are going to achieve that." - *Social Consultant*

"My ... managers have to have the ability - when you are at that point, you have to have the ability to work with people, to get the productivity from your team, to be able to set targets and deadlines for them and monitor it. Those are things that are key that you need to be able to do." - *Technical Manager*

(6) *Managing crises*

Managing crises both technical and human is part of the business sense required by decision-makers and technical professional in positions of authority. Although neither appears to require specific qualifications in human resource management or development, managing people becomes a significant aspect of the work that is done in the water services sector. Competence in this aspect of the work is usually learned from a mentor and through experience.

The Senior Manager participating in the research identified two crises in his local authority that he had to address: Firstly, the restructuring of staff, and secondly, ensuring client satisfaction through accurate billing processes. Crises are not always as systemic as the two just mentioned but all require strong management and leadership to rectify.

(7) *Combining a range of competencies within project management*

Although this is particularly significant in the development of new utilities and the repair or enhancement of existing utilities the participating consultants suggested that the project managers still carry insufficient authority to successfully undertake large and meaningful projects. Project management requires a complex array of competencies, working up and down levels of authority, managing deadlines, managing tight budgets, bringing a global perspective to the project and most of all having a heart for the project.

"So as a project manager at times there is that challenge to say you need to know how far you can go, and at times you know that when you have done the act, and you know I have gone over my expected role here, which for me then as I was saying because you are at project level at times you tend to be, or the project tends to be close to your heart, you know and you want to see it succeed and you try by all means." - *Social Consultant*

Environmental awareness (2.1.2)

Awareness of environmental issues, legislation and environmental competence was not a significant competence in either the literature or the interviews. The ASCE (2004) did identify an ability to undertake risk analysis and environmental impact assessments as a core competence of technical professionals. Although debatable, a possible reason for the lack of attention to environmental issues may be the good existing environmental management system in the

organisations of those interviewed.

"I think we have a very good environmental management system through the normal controls that we have in controlling overflowing sewers, works, monitoring and controlling, ..." - *Technical Manager*

Although there is attention to controlling effluent polluting the environment there is still a large degree of water wastage.

"We spent a [large sum] purchasing water, okay, and [a large] percent is unaccounted for." - *Councillor*

Further analysis is required to assess whether this topic of Environmental awareness is a generic competency within developmental water services, or whether it is simply a further example of subject-specific knowledge addressed under Methodical competence (1).

Ethical (2.1.3)

Although ethics could be considered an intrapersonal competence of personage the authors have considered it an administrative competence because in the modern world ethics tend to be prescribed in organisations and professions, and have thereby become structured processes rather than personal values. Personal integrity and business ethics are required to facilitate adherence to professional standards and to keep the reputation of the profession (Davis et. al., 2003). Consequently, part of the ethical responsibility of technical practitioners is membership of professional societies.

"It is important for the future of our society and our professions that we determine an ethical base for our education and our employment practices. A professional needs to recognise the 'why' dimension as well as the 'what' in order to provide wisdom and understanding. Also, for the profession to attract students there needs to be an enhanced community respect for engineering" (Hinchcliff, 2000).

Ethics apply in a business sense and in a human sense with growing attention to public safety, health and welfare in the creation of projects (ASCE, 2004). The ability to weigh alternatives when values and ethics conflict is crucial in the process. Ethics is also about the value placed on the lives affected by unprofessional behaviour or intransigence and an awareness of the consequences of such actions on others.

"... put necessary controls in place to ensure that procedures - so many things when people think it's like so obvious ... sometimes it's difficult to understand - don't they find it obvious because they couldn't care - and now maybe if you are quite a diligent person you don't understand this because it's just not in your nature. ... When you get to an invoice and you sign it off, you don't have to be an accountant but if you sign it you check that the quantity at the bottom equals the quantities added. You consider it your responsibility even when you are not an accountant and yet some people who are actually in the accounting side don't think it's their job." - *Technical Manager*

Concern about the level of ethical decision-making by councillors was expressed by the interviewees on the score sheets. In the interviews the most disconcerting account of ethical violations came from the Technical Consultant. He described how many officials at all levels of decision-making have alternate sources of income in the transport and catering fields and that some of these people expect favours in order to sign off on contracts. He recounted a personal story of an official who held up payment for work done because an 'agreement' had not been reached.

"Yes, these are basic issues of they will not process a certain contractor claim, they have their final say on a consultant's claim, because you have not agreed to what the take is, at a certain percent or whatever. So then if you manage to get a thing up to there then it gets blocked because you don't have an agreement. Now I'm talking you get this daily and they don't get their invoices paid or they don't get that done because it is not agreed to. ... They will tell you that it is the bureaucratic problem, it is not a bureaucratic problem. That has nothing to do with bureaucracy it has to do with people's interest and the decadence I am referring to about this sitting here." - *Technical Consultant*

Time management (2.1.4)

Planning and scheduling is considered one of the six most significant competencies required by employers (Lee, 2003). Time management involves a number of personal attributes some learned and some competence of personage. To ensure effective use of time an individual must be able to remain focused while dealing with multiple demands on his/her time (Davis et al., 2003).

Rather than individual weakness in administrative competence it appears that bureaucratic structures are the primary factor negatively influencing time management.

"In some cases local authorities create administrative structures and new procedures that are unproductive because it is not well thought through. It is not well thought through, it could be done better, it is duplicated, you have done it before, you have done it in a different way. You just feel that you have so much of this other work to get on with and here you are having to spend eight hours on something when you have already spent eight hours on it." - *Senior Manager*

The councillor also noted that in a new dispensation, where engaging stakeholders is valued, some technical professionals have not developed a concomitant time management system to account for the interactions with people and their needs.

"Now in the planning process they need to factor that in, when they say this project must be completed in time. It is no longer just a technical process, it is only then they move in and then they are out. But they now have to engage the stakeholders, people who want to be part of what is happening, you know why you are doing, what you are doing, and it is going to take time for people to factor that in." - *Councillor*

Time management was not a significant factor in the discussions of the interview participants but did feature in the score sheets (Tables 3.2 and 3.3) where the interviewees suggested the time management of councillors as an area of serious concern in service delivery. Although delays in water services provision are common it may be that a lack of other competencies impact on such

delays more than ineffective time management.

Intrapersonal (2.2)

Listening (2.2.1)

Davis et. al. (2003) identify the need for people operating in the basic services sector who will listen and observe to better understand the clients' needs. The participants in this study frequently referred to the capacity to communicate as a significant competence in the sector. However the communication to which they referred always involved talking or explaining to stakeholders rather than listening to the stakeholders.

"... it means that you are going to be speaking to the communities and that opens the door for people either to want to listen to you, or opens the door for debate or you are not giving me enough or whatever the case might be." - *Technical Manager*

Comments were made about the importance of dealing with stakeholders and communities but again this invariably involved the decision-maker or technical professional basing decisions on their observations and explaining decisions to the community rather than actively listening to needs as expressed by the community. Invariably any listening appeared to be passive, aimed at giving the decision-maker or technical professional enough information to work out what the community needs.

"You are engaging with the people, and therefore that you know what the needs of the communities are, because that then forces you to have a precinct line ... when you are able to say this is what the needs are, and this is what the community needs, this is how the community thinks, their neighbourhood needs to look like." - *Councillor*

The only reference to active listening came from the Senior Manager when referring to his agenda to listen to technical staff thereby ensuring that they felt valued and part of the service delivery process. It appears that it is even common place for those involved in the implementation of water service provision to be ignored or have their insights and professional opinions downplayed.

"This listening to others, I am going to change that. There is a lot of frustration caused by officials feeling that their views or their knowledge of something is not listened to and politicians just do X anyway." - *Senior Manager*

Peschges and Reindel (1998) consider the ability to recognise and understand problems from different viewpoints one of three key competencies in the provision of water services. It appears from the interviews undertaken in this study that both decision-makers and technical professionals are more inclined to use passive listening techniques for the purpose of making their own decisions and drawing their own conclusions which are then imparted to communities.

It is conceivable that active listening to stakeholders, whether communities or employees, is a shortcoming in our system and possibly an area that requires significant attention for improvements in the actual delivery of services to communities.

Creativity / innovation (2.2.2)

Commitment to innovation requires a degree of initiative and risk taking to overcome obstacles and attain objectives (Davis et al., 2003). Innovation requires the ability to think creatively and the capacity to apply learned knowledge to ensure the successful outcome of an innovation. Peschges and Reindel (1998) combine creativity with communication as one of three key competencies. At the current levels of water provision to individuals and communities there is a great need for creativity and innovation in the solution of the problems of water services provision. However the interviewees expressed serious concern about the capacity of technical water professional to think creatively and produce innovative solutions to the challenges facing the water services sector.

"It [provision of water] is a very complex thing; it's a very practical thing. So what do you do, you can say okay we are putting infrastructure on privately owned land to provide water, no [this is against policy], but you must still ensure that they have access to water, but in this case your options are very much limited. At best you would be able to send a water tanker there, ..." - *Councillor*

It is the kind of dilemma described by the Councillor that requires high levels of creativity and innovation by the legislators, decision-makers and technical professionals in the developmental water services sector. The problems are complex and widespread, and without new and innovative ways of seeing the problems and developing the solutions, solving these problems remains a very difficult challenge.

Adaptable (2.2.3)

Adaptability or flexibility is needed to cope with changing demands of clients and communities (Davis et al., 2003). These changes may even occur within projects. An effective response to change is not sufficient. Change management is needed to ensure effective project outcomes.

Adaptability in our current context in the water services sector is critical because of the shortages experienced by many users, the high levels of urbanisation, the ease with which people cling to old ways of operating in a transformed context. In particular the interviewees expressed concern regarding the technical professionals' capacity to adapt to changing circumstances (see Tables 3.2 and 3.3). As illustrated by remarks made by the Councillor, it is particularly critical for technical professionals to exhibit high levels of adaptability:

"You have this process of urbanisation and rural/urban integration, which suggests that literally thousands and thousands, millions of people will end up in cities. I do not think that technically people rationalised what that means." - *Councillor*

Awareness of self in context (2.2.4)

Motivation is a central attribute in the design and implementation of water services. Motivation may be observed in the initiative demonstrated to overcome obstacles and maintain focus on core activities during competing demands (Davis et al., 2003). Davis et al. (2003) considers motivation a high utility competence of personage required throughout a practitioner's career.

To more fully understand how people perceive and act in the context in which they find themselves, it is important to make greater sense of the context itself. The context as elaborated by the participants is explored in Chapter 2.

Sadly, it appears that the context is a limiting rather than enabling factor in the provision of water services to communities. Those aware of the context, aware of the plays for power within that context and aware of how they fit into the context tend to withdraw and establish rituals to avoid trouble rather than demonstrate innovation and creativity. In this case changes to the context appear necessary to change the behaviour of those, possibly very competent and certainly aware of their role in the context, who are sidelined or find themselves isolated in the current situation.

The quotes below illustrate the need for an awareness of self in context, an implied acceptance of one's role in that context and the sometimes debilitating context in which individuals operate and make decisions.

"... there was jockeying for power, and you were caught in the middle." - *Senior Manager*

"You are told you are wrong for doing something. All right make a mistake, but rather do something, as opposed to being worried about doing something because you are going to get blamed, and I think there is quite a lot of that sort of very much a cover your butt strategy in a lot of government strategies." - *Senior Manager*

"So to me it became clear that your technical people, their ability to deal both with the political system, and the community is very important, because if it is a problem that only you understand as an engineer, you are going to be a very frustrated person. " - *Councillor*

"In water and sanitation in this case, and remember again as a water and sanitation person you are not the guy who decides what townships gets established." - *Councillor*

"So it means now here after the contractors were kind of delayed because of stopping work and you don't want to act because if you do you might be punished to a certain extent, so you have got to work for those kind of systems." - *Social Consultant*

Interpersonal (2.3)

Team work (2.3.1)

Teamwork and co-ordination is considered one of the six most significant competencies required by employers (Lee, 2003). Peschges and Reindel (1998) consider team work one of three key competencies. Team leadership is closely related to people management. A key function of leadership within a team is the development of good working relationships (Lee, 2003) and respect for the members of the team (Davis et al., 2003). Team success must be valued as much as individual success. Working on multi-disciplinary teams is required in an age when specialist knowledge is so advanced (ASCE, 2004). Technical specialists should develop the capacity both to lead teams and to work as a member of a team, collaborating with people from diverse disciplines and facilitating the integration of knowledge and varying perspectives.

People management and leadership (2.3.2)

People management is considered one of the six most significant competencies required by employers (Lee, 2003). People management entails the ability to lead through initiative, inspire coworkers and enable professional development. People management is strongly associated with good listening skills (Lee, 2003) something that was significantly under-reported by participants in this study. Even the Technical Manager expressed the need for competence in people leadership amongst middle level management.

"I would still have of them [middle level managers] an expectation of being able to deal with people because they do work with staff, they have staff, so they've got to have the ability to deal with their staff." - *Technical Manager*

Working with stakeholders (2.3.3)

Practitioners are required to work effectively with clients and/or the community. They should be client focused and seeking feasible valued solutions for the clients (Davis et al., 2003). In particular understanding the needs of the client and negotiation are considered significant competencies (DEBS Project Team, 2001). Competence in working with stakeholders is closely associated with competent communication. Without competent communication on the part of the practitioner the working relationship with the clients can be severely compromised. A key aspect of working with stakeholders is understanding the solutions presented by practitioners in the socio-cultural and socio-economic context in which the solutions will be carried out (ASCE, 2004).

The ability to work with all stakeholders encompasses many of the competencies laid out above. In some way this is a unifying competence, often neglected in tertiary education, but vital in the effective delivery of service to communities. ASCE (2004) sums up this need:

"This complexity emerges in an era when the public is playing a more active role in private and public projects alike, through more open planning processes, environmental regulations, and elevated community expectations that place greater responsibility on those executing project developments. To be sure, this involvement from end-users and stakeholders provides valuable input, but it adds an element of complexity to the way projects are conceived, planned, designed, and built."

Although they are speaking of an American context this statement is certainly relevant to South Africa. In developed nations many of the water services delivery processes are predetermined and preplanned whereas in South Africa, where resources are scarce, the delivery of water services requires far more interaction with stakeholders in order to determine the level of service that is humanly acceptable and sustainable.

Although this is a significant interpersonal competence in developmental water services provision, working with stakeholders can easily be neglected. For example, when the Technical Manager was asked by the interviewer, "As a young civil chemical engineer who's maybe had a year's experience of some kind, where would they be most inclined to fit into your structure?" he answered:

"On the [reticulation network] side they could possibly come in on our new connections, new customers side. The reason why I say that is because that is a little bit more orientated towards - when you do some basic calculations and things like that. I am wary giving a person with one year experience, letting them loose on managing people, particularly in this sector because unless you have the right and mature attitude, ... , you could cause more chaos than anything else. So I would start off there because it's as if they are dealing a bit more with numbers and things and stuff like that and they are dealing with customers, that's different to dealing with staff." - *Technical Manager*

Although one needs to be careful not to take the comment out of context, there is an indication that the Technical Manager might consider working with stakeholders to be less complex than working with team members within the department. This is indicated by his apparent preparedness to allow a young engineer - who conceivably would have little formal training in human communication and almost no experience in interacting with the clients of a water services provider - to interact with stakeholders before managing any departmental staff. The Technical Manager's reaction confirms the claims of the councillors:

"Because you see again I guess it has to do with this issue of community participation, in short with engineers because to them they know what must be done, they must move in there, send contractors, they can move on. You know why must they engage with the local community." - *Councillor*

The councillor argues that technical professionals are reluctant at best to consider consumers as stakeholders in the decision-making process. The need to engage stakeholders is then stressed in a further comment:

"It is no longer just a technical process, it is only then they move in and then they are out. But they now have to engage the stakeholders, people who want to be part of what is happening, you know why you are doing, what you are doing, and it is going to take time for people to factor that in." - *Councillor*

Social competencies and competency of personage are the areas of greatest concern expressed by the interviewees both during the interviews and on the score sheet. There appears to be little formal education in social competencies and attention to the development of competencies of personage is lacking. The growth and development of these competencies takes time, continuity of effort and human resources. As such solutions to a lack of these competencies will require further research and a long term human effort.

Communication (2.3.4)

Employees are expected to demonstrate effective interpersonal communication and communicate well in oral and written presentation of information (ASCE, 2004). Interpersonal communication was listed as the most significant competency required by engineering employers (Lee, 2003; El-Raghy, 1999; DEBS Project Team, 2001). Peschges and Reindel (1998) consider communication one of three key competencies. In addition employers also expressed dissatisfaction with the interpersonal communication of employees. This is particularly significant when working in multi-disciplinary teams or across diverse socio-cultural groupings.

Presentation and effective use of language is important when communicating with stakeholders, writing reports, sharing information across varying levels of technical expertise, and seeking funding and grant writing. Employers have also expressed concern in these areas of communication (Briggs and Hodgson, 2000). Conciseness and clarity in expression is important when communicating with stakeholders (Davis et. al., 2003). In contrast to the importance and significance ascribed to communication in the literature the research found that written communication was identified as a significant weakness of technical professionals and decision-makers in the water services sector by all interviewees (Tables 3.2 and 3.3).

Quite apart from the quality of either oral or written communication, interpersonal communication and the awareness of your own role and the role of others in decision-making, implementation and evaluation is critical. Technical professionals wishing to communicate with decision-makers in political office need to frame their communication with reference to political agendas. Providing information in a factual mode with a passive voice does not attract the attention of the decision-maker. It appears from a number of comments that the information must appeal to the "correct" political agenda rather than explain the finer details of the project. The evidence suggests that the decision-makers want to hear the technical process in terms of the political consequences rather than the economic or technical implications.

"So then I said okay, how about we remove buckets. ... Eradication of buckets! So we come back to say one of the key focuses is there are buckets and when you say 'buckets', now everybody likes the idea of eradicating buckets and then they listen. So those who have buckets in their communities, now you get in the politicians firstly, who were very agitated about buckets, they hate them, because they come from the apartheid era. So we got the immediate attention of the politicians and so they go back to their officials, and they say right we are eradicating these buckets. - *Technical Consultant*

"It became clear that your technical people, their ability to deal both with the political system, and the community is very important, because if it is a problem that only you understand as an engineer, you are going to be a very frustrated person." - *Councillor*

Judgment (3)

The ability to draw information from different sources and evaluate the information against criteria is fundamental in the exercising of sound judgment (Davis et. al., 2003). Judgment is of little value without a resultant decision made in the spheres of administration, economics and the social setting. These decisions are not technical decisions made through problem solving but rather judgments made through a process of analysis of the needs of people and the socio-political context. The scores allocated by the interviewees on the score sheets indicate that the judgment exercised by councillors is an area of grave concern in the delivery of water services to the public. Furthermore, the ability to evaluate the viability of a decision is as much part of good judgment as the initial judgment and decision (Davis et. al., 2003).

It may be that the type of judgments needed in the field of water and sanitation require a structured context and prescribed decision-making with little scope for judgment. Consequently, the fear of reprisal for making judgments is real and as described earlier inhibiting and debilitating. It should be added at this point that a structured context and prescribed decision-making is not forced upon government, but is in fact a choice that government has made in its

manner of operating - and which has both positive (stability) and negative (inflexible/inhibiting) consequences.

"So it means now here after the contractors were kind of delayed because of stopping work and that and you don't want to act because if you do you might be punished to a certain extent, so you have got to work for those kind of systems." - *Social Consultant*

"It is not a bureaucratic issue and those people are not making decisions because their heads are on the blocks." - *Technical Consultant*

"It is people scared to make a decision, there is not enough push from the top, there is too many conflicting hands coming in, I don't know, but there is something that happens there." - *Senior Manager*

Investment in an individual's sound judgment may however be an underutilised resource particularly in unique situations and crises. The manager suggested that what is often lacking in decision-making is common sense.

"You have to be able to also in any of these things in life, in job and decision-making be able to use common sense, and use intuition. Sometimes the system itself can suppress that, sometimes in government more so than in other places." - *Senior Manager*

Although the authors of this study have chosen to explore judgments as a particular competence in water services provision, judgments are in fact evident in and underpin *all* the competencies described in this investigation. Business sense, communication, knowledgeable analysis and such competencies can never be performed without overarching judgments taking place throughout the process. For example, the Councillor indicates the judgments required in a budgetary process.

"... in this case take the budget as a reflection of your priorities, and those priorities would have as a base the inputs from various communities, be it the need for roads, for water, for parks, for schools, for clinics, libraries, primary healthcare, everything." - *Councillor*

3.3 Further individual characteristics

While competencies are clearly a key characteristic of performance of individuals and disciplines, and are a major focus of this investigation, there are a number of other characteristics which may provide methods and tools for understanding and improving the performance of individuals and disciplines within the sector. Three characteristics (with some overlap between them) are considered briefly in this section as follows:

- (1) Thinking style
- (2) Cultural orientation
- (3) Learning style

Although, as indicated in the introduction, this project has focused on 'what' knowledge uptake is taking place and/or ought to be taking place, brief comment is made - within the context of learning style - on 'how' knowledge uptake is taking place, and on the use of WRC research reports in knowledge uptake.

Thinking style

The notion of different disciplines being characterised by different *thinking styles* has been investigated by researchers from very different areas: In the coaching field, Bennett (2000: p.21-23) uses the Herrmann Brain Dominance Inventory (HBDI) as a "...self-administered inventory tool to look at thinking styles", which he suggests are "...very valuable in achieving excellence in the areas of leadership, teamwork and communication" (Bennett, 2000: p.48). The model "...looks metaphorically into four quadrants, four thinking styles or four different thinking selves found within the brain. These selves include the rational self [A], the safe-keeping self [B], the feeling self [C], and the experimental self [D]." (Letter labels given on p.49, but added to the above quote). He suggests that a team should preferably consist of the full spectrum of thinking styles. He points out that certain thinking styles predominate in certain types of work, that people with thinking styles from particular quadrants tend to communicate easily with those of their own quadrant and adjacent quadrants, but have difficulty in communicating to opposite quadrants. What he suggests is that one uses a person from a 'in-between' quadrant as an interpreter between people from opposite quadrants (Bennett, 2000: p.83).

In a study of the thinking styles and academic performance of civil engineering students at the University of Pretoria, Horak and Du Toit (2002) also made use of the Herrmann Brain Dominance Inventory (HBDI), which they applied to their students. They found a strong preference for quadrants A and B, very slightly lower preference for quadrant D, but a lower preference for quadrant C. Interestingly, male students indicated an even stronger preference for quadrant A, coupled with a weaker preference for - bordering on avoidance - for quadrant C. Female students on the other hand, showed the reverse, with roughly even preferences for quadrants A and C.

Cultural orientation

A more comprehensive approach in similar vein has come from the area of *coaching across organisational cultures*. Coaching (as in business coaching) is generally focused on the *workplace* and on *practice* - as against formal educational institutions - and towards learning within the context of the organisation, which makes it pertinent to this particular study.

Rosinski (2003: p.4) defines *coaching* as "the art of facilitating the unleashing of people's potential to reach meaningful important objectives" He also goes on to explain the differences between mentoring, therapy, consulting and teaching. Rosinski suggests that *culture* is critical - and it needs to be pointed out immediately that the cultures that he talks about are not primarily national cultures, but rather professional and organizational cultures - and that is what is pertinent to this study. In fact, he suggests (Rosinski, 2003: p.21) that we belong to multiple groups, and therefore operate within multiple cultures. Some of the categories that he suggests these groups may originate from include:

1. Geography and nationality, region, religion and ethnicity;
2. Discipline: profession, education
3. Organizations: industry, corporation, union, function;
4. Social life: family, friends, social class, clubs;
5. Gender and sexual orientation.

Rosinski (2003: p.20-21) suggests a working definition of *culture* - referring primarily to organisational culture - as follows: "A group's culture is the set of unique characteristics that distinguishes its members from another group". He goes on to suggest that the definition "...encompasses both *visible* (behaviours, language, artifacts) and *invisible* manifestations (norms, values, basic assumptions and beliefs)", and points out that this definition "...goes to the essence of culture: it is a *group* phenomenon as opposed to an *individual* reality".

With respect to *changing organisational cultures*, Rosinski (2003: p.17-18) gives an example of a company that includes both nurses and business managers as a result of the nurses' organization being bought out by another business. This may be of relevance to developmental water services in as much as the change in organizations and the role of different disciplines constitutes a change in organisational culture.

An approach that Rosinski (2003, p.23) suggests, that appears to hold promise for understanding the technical and political approaches in developmental water services, is that of looking at the problem from different perspectives: "Coaching from multiple perspectives attempts...to shift views, in a kaleidoscopic manner, to look at issues from various angles, each with potential merits, to facilitate progress".

As a tool in understanding and addressing these differences in culture, Rosinski presents what he calls a 'Cultural Orientations Framework' (Rosinski, 2003: p.54-55), which sets out in a systematic manner a number of these different orientations, grouped into different categories and dimensions, and which are set out in Table 3.4. This framework provides a checklist for '...looking at reality from [different] angles' (Rosinski, 2003: p.184), which is critical for bridging cultural divides.

TABLE 3.4:**CULTURAL ORIENTATIONS FRAMEWORK (Rosinski, 2003: p.54-55)**

Categories	Dimensions	Description
Sense of Power and Responsibility	Control/Harmony/Humility	Control: People have a determined power and responsibility to forge the life they want Harmony: Strive for balance and harmony with nature Humility: Accept inevitable natural limitations
Time Management Approaches	Scarce/Plentiful	Scarce: Time is a scarce resource. Manage it carefully! Plentiful: Time is abundant. Relax
	Monochronic/Polychronic	Monochronic: Concentrate on one activity and/or relationship at a time. Polychronic: Concentrate simultaneously on multiple tasks and/or relationships
	Past/Present/Future	Past: Learn from the past. The present is essentially a continuation or a repetition of past occurrences Present: Focus on the "here and now" and short-term benefits Future: Have a bias towards long-term benefits. Promote a far-reaching vision.
Definitions of Identity and Purpose	Being/Doing	Being: Stress living itself and the development of talents and relationships Doing: Focus on accomplishments and visible achievements
	Individualistic/Collectivistic	Individualistic: Emphasis individual attributes and projects Collectivistic: Emphasise affiliation with a group
Organisational arrangements	Hierarchy/Equality	Hierarchy: Society and organisations must be socially stratified to function properly Equality: People are equals who often happen to play different roles
	Universalist/Particularist	Universalist: All cases should be treated in the same uniform manner. Adopt common processes for consistency and economies of scale Particularist: Emphasize particular circumstances. Favor decentralization and tailored solutions.
	Stability/Change	Stability: Value a static and orderly environment. Encourage efficiency through systematic and disciplined work. Minimise change and ambiguity, perceived as disruptive Change: Value a dynamic and flexible environment. Promote effectiveness through adaptability and innovation. Avoid routine, perceived as boring.
	Competitive/Collaborative	Competitive: Promote success and progress through competitive stimulation. Collaborative: Promote success and progress through mutual support, sharing of best practices and solidarity
Notions of Territories and Boundaries	Protective/Sharing	Protective: Protect yourself by keeping personal life and feelings private (mental boundaries), and by minimising intrusions in your physical space (physical boundaries) Sharing: Build closer relationships by sharing your psychological and physical domains
Communication Patterns	High Context/Low Context	High Context: Rely on implicit communication. Appreciate the meaning of gestures, posture, voice and context. Low Context: Rely on explicit communication. Favor clear and detailed instructions
	Direct/Indirect	Direct: In a conflict or with a tough message to deliver, get your point across clearly at the risk of offending or hurting Indirect: In a conflict or with a tough message to deliver, favor maintaining a cordial relationship at the risk of misunderstanding
	Affective/Neutral	Affective: Display emotions and warmth when communicating. Establishing and maintaining personal and social connections is key Neutral: Stress conciseness, precision and detachment when communicating
	Formal/Informal	Formal: Observe strict protocols and rituals Informal: Favor familiarity and spontaneity
Modes of Thinking	Deductive/Inductive	Deductive: Emphasize concepts, theories and general principles. Then, through logical reasoning derive practical applications and solutions Inductive: Start with experiences, concrete situations and cases. then, using intuition, formulate general models and theories
	Analytical/Systemic	Analytical: Separate a whole into its constituent elements. Dissect a problem into smaller chunks. Systemic: Assemble the parts into a cohesive whole. Explore connections between elements and focus on the whole system

Learning style

The learning styles of the interviewees - similar to Rosinski's 'Modes of Thinking' - were tentatively assessed in the in-depth interviews. The assessment was carried out simply by presenting a verbal description of three pairs of characteristics, accompanied by sketches illustrating each. Interviewees were asked to assess which categories they fell into. Results were as follows:

TABLE 3.5:

SELECTED LEARNING STYLE ATTRIBUTES OF INTERVIEWEES (after Felder and Silverman, 1988; preface added by Felder, 2002; sketches: Felder and Brent, 1996: p.A7)

	Input modality		Processing		Understanding	
	Visual	Verbal	Active	Reflective	Sequential	Global
#1						
#2	X			X		X
#3	X			X	X	
#4	X		X		X	
#5	X			X		X
ave	100%	0%	25%	75%	50%	50%

While the sample size was small, it is particularly noteworthy that all four interviewees - without hesitation - indicated that they preferred visual to verbal communication, which is in line with the results of a number of international surveys on learning (Felder and Brent, 2005: Table 1, p.61), but in striking contrast to the format of presentation of most research outputs.

These learning style results were further supported by the impression gained by the researchers in the interviews that the interviewees did not generally read Water Research Commission reports in any depth - if they read them at all. They may possibly have read a review or an executive summary. Technical personnel generally *knew of* the Water Research Commission. Non-technical personnel, on the other hand, appeared uncertain at the mention of the name of the Water Research Commission. As a consequence of this, it was necessary - certainly for non-technical personnel - to add at the start of our interviews a brief explanation of who the WRC was, what they did, the research they produced and to explain that the research proposal itself had gone through a fairly rigorous review and selection process even before getting to the actual research stage - in which the interviewees were now participating.

Saywell and Cotton (1999: p.16-17) make a similar point in noting that although there is a large range of possible dissemination media, there has been '...undue emphasis placed on disseminating research findings via the written word, even though this medium in itself is not the most effective means of communication (Stapleton, 1983)'. They go on to say that '[t]alking about research through face to face contact is increasingly recognised as a key means by which those concerned with policy, as well as practitioners, learn about issues that concern them (Streatfield and Wilson, 1980, as cited in Richardson, 1990)'. The point is relevant to this study in that it focuses attention on the *individual*, and on individual contact. In the same vein, Saywell and Cotton (1999: p.19) also refer to the fact that '...the World Bank (1999) advocates the use of intermediaries when transferring internationally available knowledge'.

3.4 Conclusions

1. A framework of competencies for the developmental water services sector as a whole (including technical professionals and decision-makers), drawn from both the literature and the interviews, was constructed and is set out in Table 3.1 (see p.32). What is suggested is that individuals emanating from different disciplines may be stronger or weaker in particular competency areas, but that the full range of competencies should be covered by the sector as a whole. In most cases, the interviews supported, enhanced or confirmed the evidence in the literature. In some cases participants in the study stressed issues not identified in the literature.
2. A distinction needs to be drawn between *existing* competence (i.e. what individuals *can* do) and *threshold* competence (what individuals *should* be able to do). The evidence obtained from the interviews, however, did not always distinguish between the two.
3. The competencies were classified as *methodical competencies* and *social competencies or competencies of personage*. Methodical competence (MC) involves learned competence in the discipline or field. Social competence and competence of personage (SCCP) involves the capacity to work with various stakeholders in the context of work and personal attributes that are necessary to more (or most) effectively complete the work at hand.
4. Decision-making, that requires the ability to understand, interpret or analyse technical or mathematical information, in the provision of water services requires (amongst others) three levels of methodical competence, namely: (a) numeracy; (b) knowledgeable analysis; and (c) problem solving.
5. *Numeracy* (as defined here) consists of more than being able to do simple arithmetic. Numeracy includes the ability to interpret graphical information, perform basic calculations to check information and visualise what the product of drawn plans or models may look like. It also includes some basic knowledge of engineered systems. For example, a numerate person understands the basics of water flow in a reservoir or sanitation system. Without this basic numeracy, communication between technical professionals and decision-makers who are not educated in the technical aspects of the water and sanitation process is virtually impossible.
6. *Knowledgeable analysis* involves the ability to not just understand, but interpret and analyse information and use the information in decision-making, and includes the following abilities:
 - (a) compare information, looking for contradictions or reinforcement of ideas;
 - (b) determine the relevance of given information to a situation;

- (c) interpret and analyse information seeking those aspects that are salient or central to the situation and demonstrating an understanding of the consequences of acting on the information;
- (d) evaluate the viability of given solutions and identify potential pitfalls; and consequently;
- (e) plan water and sanitation provision over time and space.

In essence, knowledgeable analysis requires competence in working with other people's solutions rather than finding your own. In the first world literature, knowledgeable analysis is seldom discussed, but is included under other higher order methodical competencies such as problem solving.

7. *Problem solving* involves the ability to evaluate and analyse a situation with nothing given, identify and obtain appropriate methods and data and then apply the methods to solve the problem. Problem solving is a complex high order methodical competence because it requires the ability to problem pose and to evaluate the relevance, accuracy and authority of data and data sources. Problem posing also has significant links to creativity and innovation (included separately under the social competences and competences of person (SCCP)).
8. It is clear from the research that only technical professionals require high levels of *problem solving*. As a basic minimum, participants in the sector should at least be *numerate*. A lack of numeracy can have a significant impact on the quality of decision-making. It appears that most decision-makers in the water sector are numerate. However, examples of decision-makers not understanding why a water reservoir needs to be higher than the housing it services are in evidence. The level of knowledgeable analysis required to participate in the water sector is not clear. Some interviewees expressed concern at the low level of knowledgeable analysis demonstrated by decision-makers in the sector.
9. *Judgement* may be one of the most important competencies in South Africa where limited financial resources restrict the availability, choice and sustainability of services. Although it appears to the researchers that knowledgeable analysis, a business sense, active listening and working with stakeholders are key competencies in making sound judgements, the foundational basis for sound judgement remains unclear and was not a focus of this research.
10. The participants' lack of comment or attention to *actively listening* to others is in our estimation a serious shortcoming. This appears to be a shortcoming in all parties in the developmental water service sector. It may be that this limits the technical professional's capacity to work with stakeholders, a difficulty raised by consultants and decision-makers in the interviews. In addition, not listening would clearly exacerbate decision-makers' inability to acquire the knowledge necessary for analysing and may lead to some of the frustrations technical professionals experience when their advice is ignored.
11. Technical professionals struggled to work well with stakeholders and it appeared to some interviewees that technical professionals could not always discern who the stakeholders were.
12. In general participants in the sector expressed concern at the low level of written communication.
13. While competencies are clearly a key characteristic of performance of individuals, and are a major focus of this investigation, there are a number of other characteristics which may provide methods and tools for understanding and improving the performance of individuals and disciplines within the sector, including (a) Thinking style; (b) Cultural orientation; and (c) Learning style.

14. With regard to one of these aspects, namely learning style, although the sample size was small, it is particularly noteworthy that all four interviewees without hesitation indicated that they preferred visual to verbal communication. This is in line with the results of a number of international surveys on learning (Felder and Brent, 2005)³, but in striking contrast to the format of presentation of most research outputs, including WRC reports, which are generally verbal (written) rather than visual (diagrammatic or pictorial) in format. Furthermore, evidence from a number of interactions indicates that high-level technical professionals and decision-makers in practice do not generally appear to be reading WRC reports. This provides a very brief initial indication of individual preferences for *how* knowledge might be taken up, as against *what* knowledge is - or should be - taken up (which is the primary focus of this investigation).

³ Felder, R M and Brent, R (2005) Understanding Student Differences, *Journal of Engineering Education*, Vol. 94, No.1, pp.57-72.

4 METHODOLOGY

4.1 Overview

As indicated in the Overview of methodology (Section 1.5) in the Introduction, the methodology consisted of two primary research strategies:

1. a *review of the literature* on the topics of (a) developmental water services provision; and (b) knowledge uptake and related factors, both individually and in combination.
2. *in-depth case studies in the form of interviews and interactions* with 5 technical professionals and high-level decision-makers in the sector in urban/ peri-urban areas.

Two secondary research strategies were employed to support the primary research strategies:

1. The in-depth case studies were preceded by *observation of typical institutional arrangements and decision-making processes* mainly in local government, which (a) provided further insight into the nature of developmental water services, and (b) enabled the researchers to identify and obtain access to the *context* within which individuals were operating, as well as to identify appropriate and representative *individuals* for the in-depth case studies.
2. The in-depth case studies were then followed by an *abbreviated postal/telephonic survey* of knowledge uptake by technical professionals/decision-makers across the sector, including a further 4 individuals and consisting of about 10-15 questions, to obtain a slightly broader sample of views on the key issues identified within the in-depth case studies. (In practice, the abbreviated survey tended towards a number of additional in-depth interviews - albeit abbreviated).

The investigation focused on the individual, and explored the uptake - meaning the acquisition, comprehension and application in context - of knowledge on developmental water services. The three components, therefore, that the investigation explored were:

1. knowledge/information (on developmental water services);
2. context; and
3. individual.

The sequence in which these components were explored was as follows:

1. The investigation started with a literature review of *knowledge/information* on developmental water services.
2. This was followed by a literature review of knowledge uptake by the *individual*.
3. However, in investigating the *individual*, it was found that one could not make sense of the required characteristics of the individual without also investigating the *context* in which the individual was operating.
4. Investigation of the individual and context in turn led back to a re-examination of the *knowledge* - raising questions as to whether it was appropriate to the *context* (and to the *individual*).

Within the study, *knowledge* and *context* are addressed under the heading on developmental water services. *Individual* characteristics are addressed under the heading of competencies.

As indicated earlier, one does not (and cannot really) measure directly what knowledge is taken up by an individual in the sense of what is acquired and comprehended by the brain; nor is it particularly important. Rather, as evidence that knowledge has been taken up, one measures what the individual can *do* with that knowledge. Knowledge uptake is therefore demonstrated through competence. Knowledge must be visible and used in practice for it to be considered taken up by an individual. Consequently, knowledge uptake is best explored by considering those competencies that are observable in the decisions, discussions and actions of technical professionals and decision-makers. The *methodology* which has been developed in this study is one which enables those observations to be made.

4.2 Literature reviews

With respect to the two literature review topics, our understanding at the start of the research had been as follows:

1. *On developmental water services:* There was a lot of information readily available on the topic.
2. *On knowledge uptake:* It was with the individuals rather than the organisations where the deficiencies lay, and a particular deficiency was that the available knowledge was not being taken up by non-technical decision-makers.

As the research proceeded, in both cases, our initial understanding proved only partially correct. What we found in the literature reviews has been described in earlier chapters. In terms of methodology, probably what was most important was to continue referring back to - and reassessing - the literature as the research proceeded to the in-depth case studies. However, it was in gaining access to both context and individuals, as well as the in-depth interviews themselves, that required the development of specific approaches and methods, and which are described in the following sections.

4.3 Gaining access to the context and to the individuals

As indicated, gaining access to both the context and to the individuals was critical to the in-depth case studies:

1. *Gaining access to the broad context or environment* in which technical professionals and high-level decision-makers operate, observing *typical institutional arrangements* and *typical decision-making processes* i.e. the typical system of committees by which decisions are taken;
2. *Gaining access to individuals* across several institutions and across several different parts of the developmental water services arrangement.

Gaining access to individuals for in-depth interview purposes was a *progression rather than an event*, which started long before any formal application for an interview, as follows:

1. *Initial contact or pre-approach phase:* Before even making the approach, there needed to be some form of contact with the organisation - and, if possible, with the individual - which required involvement by the researchers in a range of initiatives at a relatively high level over an extended period of time. Without this involvement, it would have been

difficult to obtain access to the individuals for the interviews.

2. *Approach and appointment phase:* Even following the initial contact or pre-approach phase, it did not generally prove possible to dive straight into a request for an in-depth interview. Such an approach needed to be made in two stages: (a) verbal - or brief written request accompanied by brief supporting documentation - for an *initial exploratory interview* of 20 to 30 minutes; and (b) If that was successful, then a *more detailed request* for an in-depth interview of an hour or hour and a half, with further supporting documentation.

While we did settle on certain broad procedures, the methodology - and interview methodology - was constantly being developed and refined/adjusted through all the preparatory stages, and even through the interviews themselves. *All* contact assisted in the development of the methodology. So even where initial exploratory interviews did not translate into in-depth interviews, they did nevertheless give us access to that environment and access to individuals in that environment, providing additional insight into both. Most importantly, they gave us one-on-one contact with individuals within the context of the research project, which was invaluable in developing the interview procedures. In other words, it assisted us in making the transition from passive observation to active interaction with individuals on our terms i.e. within the scope of the research project.

We encountered something of a 'chicken-and-egg' situation regarding the compilation of the interviews questions: We really needed the opportunity to talk to people in an exploratory manner in order to see what topics we could explore in the interviews, and what the critical issues were; but we were in several instances asked to state exactly what questions we wanted to ask before we would be granted an interview!

It took considerable effort and patience to convert an initial contact into an in-depth interview, and overall, within the broad time frames of the research project, time spent gaining access to the context and to the individuals was substantial. Interestingly, those individuals who asked a large numbers of questions and required a large amount of explanatory information were those who in the end did *not* grant interviews. Those who granted interviews tended to do so with fewer questions asked. Some at high levels granted interviews readily; others battled to fit us into their schedules; some made alternative arrangements for deputies to grant us interviews. For all interviews, we were most appreciative.

The individuals interviewed were representative of a spectrum of positions across the interface between technical professionals and high-level decision-makers. And although representative of that spectrum, they did in fact come from a number of different organisations.

We interviewed 5 individuals as follows:

1. Councillor (political);
2. Senior Manager (managerial);
3. Technical Manager (managerial/technical);
4. Social consultant (managerial/social);
5. Technical consultant (managerial/technical).

For the record, there was a mix of race and gender; however to disclose further details may compromise the identities of the individuals.

4.4 In-depth interview methodology

Initially, we had thought that it might be better to *conduct the interviews in two parts*. That would also give us the opportunity to review a first interview, and to prepare follow-on questions before the second interview. In practice, that was not realistic. Firstly, interviewees preferred to get it over in one 'hit'; and, related to that, it appeared that it would be very difficult to get two appointments with an individual.

Objectives of the study

In essence, the objective of the study was to understand better what the problems were confronting technical professionals and high-level decision-makers, and to *make connections* - if there were any to be made - between the problem in the *global* sense (i.e. we have made good progress in terms of policy etc.; we know quite a lot about water services; why then are we not performing better in terms of delivery, sustainability etc.?) and the *specifics* of the problems that confronted the individuals. Furthermore, we were endeavouring to do it in such a manner as to get at the problem without 'getting at' the individual. By the time we started the in-depth interviews, we had adopted a parallel approach with respect to the *objectives of the study* i.e. why we were there and what we wanted to get out of it:

1. We gave a brief statement of:
 - (a) *the problem in the global sense*: i.e. 'we have made good progress in terms of policy etc.; we know quite a lot about water services; why then are we not performing better in terms of delivery, sustainability etc.?';
 - (b) *the scope of the project*: focus on knowledge uptake - including application and use; alternatively, 'how learning happens in practice'; focus on the individual not the organisation; technical professionals and decision-makers at the higher levels;
 - (c) a *summary of early findings* primarily of the two literature reviews;
 - (d) some *ground rules*: confidentiality i.e. we were not wanting to identify either specific organisations or specific individuals.

These matters were set out in detail in the supporting documentation which accompanied the request for interviews, and are included in Appendix B.

2. Secondly, we identified four main topics for investigation:
 - (a) The *roles and tasks* that technical professionals and high-level decision-makers actually perform;
 - (b) Characterisation of the *decision-making process*, including what decisions actually get taken, and the *relationship of decision-making to detailed implementation*;
 - (c) Characterisation of the *individuals* currently performing these tasks, in terms of competencies and other characteristics that may affect the process e.g. learning style;
 - (d) Characterisation of *disciplines* operating at this level (primarily the distinction between technical professionals - nominally engineers - and politicians).

This focus did change somewhat as the interviews progressed and as topics started to emerge. We attempted to do two things: (a) to direct the interview according to the particular strengths and possible contribution of the individual; (b) to cross-check topics that may have arisen in

other interviews.

Getting interviewees to talk (and into a microphone)

We didn't know whether the interviewees would be forthcoming in talking. None of the interviewees needed coaxing to talk. More of an art, though, was to direct the conversation towards topics that we specifically wanted to address. The interview took the form of a dialogue with questions tending to follow on from one another in a 'thread', so as to retain the flow of the dialogue. It did not consist simply of a list of predetermined questions. In practice, therefore, one had to think on one's feet, leaving topics out where the conversation took a different but useful direction, and introducing our own topics where the discussion moved within range.

Our impression was that the interviewees were more apprehensive at the start of the interview, but eased up as the interview progressed. We were wanting to give the interviewees an opportunity to talk about the good things rather than the bad things. It was therefore not our intention to ask controversial questions.

We did get a sense that having a structured opportunity to give an account of what they did was *not* something that the interviewees were accustomed to.

Interview format that emerged

The *format that emerged as being manageable/appropriate* within the time available, which was more of a framework than a detailed format, and that we settled into, was as follows:

1. Brief introduction to the research project (and preliminary findings of the literature reviews);
2. Opening question: 'What does your day-to-day job entail?';
3. A variety of topics that flowed from that;
4. Formal questionnaire on the competency table, or 'tick-box time';
5. Brief questions giving pointers on learning style;
6. Brief post-interview discussion, which often included a couple of extremely useful informal anecdotes and comments.

We as interviewers were not interested in particular *individuals*. Questions were phrased as much as possible in generic terms, so that interviewees' answers referred to *groups* of several individuals and from different organisations and different spheres of government. While the views of individuals were obviously coloured by their experience of those with whom they worked, their experience - and particularly those of the support consultants - tended to be broader than any single organisation.

While the politicians/officials and technical/non-technical personnel expressed views of the other group, it was particularly useful to have the views of support consultants who could express opinions of both groups from a *third party perspective*.

Timing

We didn't know how long different topics would take to discuss. Interviews lasted 2 hours each +/- ¼ hour i.e. ranged between about 1¼ and 2¼ hours. 1¼ hours was about the limit before 'brain deadness' set in i.e. it was difficult to concentrate, and actively steer or respond to the conversation. What we did find was that in a couple of instances, the discussion 'perked up' when we switched the tape off. In other words, it did appear that the tape did add pressure to the interview. Our impression was that while the interviewees were not inhibited by the tape, it did make them consider what they said. It is possible that when the tape was switched off, one could interact without trying so hard.

Questions and techniques prepared beforehand

A number of questions and techniques were prepared for use in the interviews. Some were used. Others proved inappropriate in the circumstances. A listing of these questions and techniques, together with brief comment is given in Table 4.1 below.

TABLE 4.1:
QUESTIONS AND TECHNIQUES CONSIDERED AND/OR USED IN THE IN-DEPTH INTERVIEWS

<i>No</i>	<i>Question/technique</i>	<i>Comment</i>	<i>used/ not used</i>
1	<u>Question:</u> "What does your job entail: What do you do from day to day? What does a typical day consist of?"	<u>Comment:</u> It proved very effective to talk about the specifics, because it prevented the interviewees from switching to commonly held understanding of what the problem was.	used
2	<u>Question:</u> "What do you do to keep up with your field? What do you read? Do you read WRC research reports? Magazines? Do you go on courses? Do you ever read an academic journal?"	<u>Comment:</u> This we found most useful when linked to learning style; we felt that we could approach this topic only when the interviewee was sufficiently confident in themselves. We felt that it was too personal a question to ask until we had developed a measure of trust/rapport with the interviewee.	used
3	<u>Question:</u> "What do you enjoy about your work? What do you <i>not</i> enjoy about your work? What do you find easy? difficult? boring?"	<u>Comment:</u> While these topics were not specifically used, the topic of frustration - even exasperation! - is one that frequently arose in discussion; difficulties - with others usually - arose naturally in the context of the competency grid.	used
4	<u>Question - on decision-making:</u> "Can we isolate the decisions that get made at that level?"	<u>Comment:</u> This is a question that was explored, not so much in terms of decisions that get made, but matters that needed to be addressed; decision-making is generally a process rather than an event; it took some adjustment to separate the process from the final decision; there were of course several very difficult decisions identified as well - particularly ones to be taken by the politicians, and particularly keenly felt by the politician.	used

5	<u>Technique</u> - to get at the problem without getting at the person: (a) <i>to a councillor</i>: "Describe good traits of councillors that you know on the [local authority] Mayoral Committee, or others of your acquaintance. Don't give names, but give examples. Indicate the best one and the worst one"; (b) <i>to a senior technical professional</i>: "What sort of skills do you need when you employ someone?" OR "What questions do you ask when employing someone?"	<u>Comment</u>: This technique was used particularly in the context of the competency grid.	used
6	<u>Technique</u>: It was thought that individuals would generally be more willing to provide information about the <i>environment</i> or aspects <i>outside themselves</i>, but would generally - and understandably - be reticent to provide information that may reflect badly on themselves as individuals.	<u>Comment</u>: To their credit, all the interviewees were sufficiently confident in themselves not to worry too much about what they might not be good at. Where characteristics arose where individuals might be weak, they tended to admit it really saying that it wasn't their strong point. This does not mean that <i>all</i> individual questioning is difficult. Questions that explore characteristics to which no value judgement can be attached (i.e. neither good nor bad) - such as learning/thinking style - are generally non-threatening. Furthermore, characteristics do not need to be threatening to be useful. e.g. learning/thinking style does provide useful explanation for mismatches in communication, in that we tend to communicate in the same style that we take in or process information ourselves - which may not correspond to the preferred style of the audience.	used
7	<u>Technique</u>: Certain characteristics may be associated more strongly with particular disciplines e.g. strong numerical literacy skills, but weaker written communication skills may be associated with engineers. If one can cast the problem as a problem of the discipline rather than a problem of the individual, then it tends to be less threatening. Conversely, if one is talking to a politician who may have well-developed negotiating skills and verbal communication skills, it may be useful to contrast the strength of the person that one is speaking to with the weakness of the other e.g. If one wants to raise the matter of numeracy with a politician, it may be useful to raise the matters <i>as a means of understanding engineers better</i> (rather than as a weakness of politicians!).		used
8	<u>Question</u>: "What formal qualifications do you have?"	Not pursued; we tended to know by their positions what their qualifications were.	not used
9	<u>Question</u>: "What experience do you have? - can we see a CV?"	<u>Comment</u>: We limited our investigations to the competency grid and the learning styles diagram; again, we could largely deduce that from what we knew of the individuals.	not used
10	<u>Question</u>: "What background of 'developmental water services' did you have prior to taking your current position?"	<u>Comment</u>: The discussions led into the specifics of the context.	not used

11	<u>Question:</u> "How would you measure success in your work?"	<u>Comment:</u> In a global sense, our opening statement of the problem regarding delivery tended to be accepted; globally speaking, there appeared to be consensus on that.	not used
12	<u>Question:</u> "What do you think are the biggest challenges that the organisation faces in the next year - or 5 years?"	<u>Comment:</u> The focus was very much on the present - and of course on meeting externally-set targets. All interviewees would have set 5 year plans. There would be no particular surprises there.	not used
13	<u>Question - on decision-making:</u> "To what extent are policies imposed from above, and to what extent does the organisation (local authority etc.) make decisions themselves i.e. what are the constraints under which they make decisions?"	<u>Comment:</u> There were quite enough decisions to be taken within the organisation. Externally imposed constraints were mentioned in the form of presidential targets, but nothing really more than that.	not used
14	<u>Question:</u> "What about the use of consultants or intermediaries? To what extent do councillors or officials rely on consultants or intermediaries for detailed technical information, as well as recommendations as to the decisions themselves? To what extent are the questions 'pre-digested' by consultants/intermediaries?"	<u>Comment:</u> The role of consultants was not pursued with politicians or technical professionals; even our interviews with the two consultants did not focus on their particular role, but on the working of government departments.	not used
15	<u>Technique:</u> A specific technique to be used is to develop a case or problem, and then assess a reaction to the posed problem/situation. Some questions would need to be more closed, while other questions may be more open-ended. The more closed ones would assess a particular area of competence.	<u>Comment:</u> We managed to gain sufficient insight merely from what the interviewees had to say themselves without the prompting of a case study.	not used

Formal testing

We didn't know whether it would be appropriate to carry out any sort of formal 'tests' of the characteristics or competencies of interviewees. In practice, we didn't go that route. The use of the competency grid and learning style diagrams was achievable; but we didn't attempt to get them to fill in the full learning style questionnaire (Soloman and Felder, 2006). We felt that we had achieved as much as we could within the interview simply by getting the interviewees to understand what learning style was, to obtain an indication of their own learning style and see that there could well be value to them in the use of the tool.

An example of a specific graph that might be presented, together with a problem statement, in order to assess ability to interpret a graph is presented below. Any inability to interpret graphs or mathematical information creates difficulties in communication between technical professionals and decision-makers, if technical professionals are relying on graphs such as the one below to support an argument, and the decision-maker does not trust mathematical or graphical information. We *did* ask two technical professionals whether they had encountered problems with any politicians over interpretation of graphs. The one had not encountered the problem, but then did not have a lot of interaction with politicians where such a problem might have arisen; the other professional did have a large amount of contact with politicians, and recognised it as a major problem.

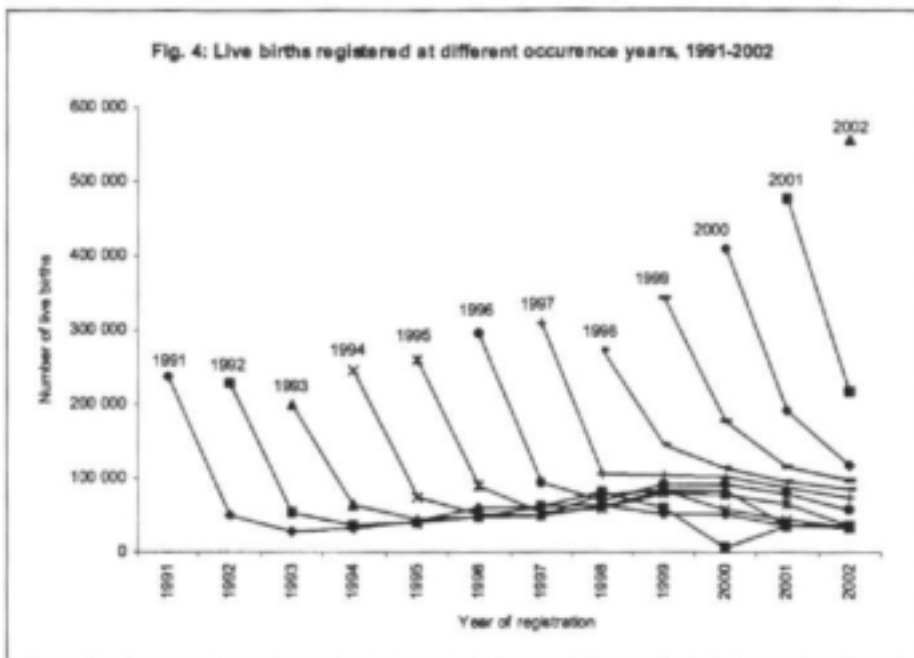


FIGURE 4.1:
SAMPLE GRAPH FOR INTERPRETATION BY INTERVIEWEE
 (Statistics release of Statistics South Africa)

Background explanation to graph: The above graph illustrates the pattern of registrations of births in South Africa. A large number of births are registered even several years after the year of birth (some only when a child wants to start school at age 7). Various mortality measures (e.g. Infant Mortality Rate) are also expressed as a proportion of the number of live births in that year. It is not possible to know the number of live births particularly in a recent year (say 2002 in the above graph) without reference to the pattern of birth registrations in previous years. Furthermore, the Department of Home Affairs can only legally register a death if the birth has been registered. As a result of the peculiarities of the registration processes, it is not possible to rely on official population register data alone for an understanding of current demographics, including current birth and death rates. For this, it is necessary to rely on demographic modelling, cross-checked against various other sources e.g. census figures plus fertility rates. In the context of HIV/AIDS, this can be contentious.

Equipment

In terms of equipment, we used a fairly substantial directional microphone in the first interview, because the built-in microphone was not good. It was a bit formidable, though, and it was distracting having to move it back and forth in the direction of the speaker. We then switched to two high quality recording machines, with high quality built-in multi-directional microphones, and 60 minute tapes (30 minutes per side). The one machine had a 'conference' facility. The other had a straight dictation microphone; however it was of good quality, and worked quite adequately. These worked well. They were unobtrusive, and picked up the interview well. We found that for an interview of three people, it was *not* necessary to use a more sophisticated

remote conference microphone. We found that it was necessary to use two tape recorders. In at least 2 of the 5 interviews, there was a 'glitch' with one of the tapes (losing track of which side had been copied and recording over a side of the interview; slack in the tape not being taken up, and jamming in the recorder). With interviews that are non-repeatable, our experience indicated that one simply needs the assurance of a back-up recording. The dual recording also proved useful for two researchers in that with two recorders (and two recordings), each could have access to a recording of an interview.

In terms of quality of machines, the cost of the machines was small in comparison with the cost of the transcriptions. It therefore made sense to purchase the best *recording equipment* that one could afford, and save on transcription costs. One would pay for poor quality recording equipment many times over in the additional costs of transcription.

Our interviews did seem to get longer as we progressed: Our first interview was just under 9 500 words; the second 10 000; the third 11 500; the fourth 13 500; and the fifth 16 000 words - as transcribed. While the reason for this may be unclear, there is certainly a progression. It is possible that we were becoming more relaxed as the interviews progressed - and that the interviewees felt more free to talk. It is also possible that we were more confident to ask interviewees questions - and probe more specifically for answers.

Analysis of the in-depth interviews and themes that emerged

It was surprising how difficult it was to read the transcribed text. It certainly provides very clear evidence that the structure and style of verbal communication is quite different from that of written communication. Interviews that seemed perfectly coherent when spoken suddenly seemed to come across as pidgin English when transcribed!

Two different approaches were used to extract key findings from the in-depth interviews:

1. Investigation of the *context* required a search for a pattern, not knowing initially what one was searching for.
2. With respect to the *competencies*, an initial framework compiled from the literature provided a good indication from the outset of what to search for; however, the key finding was what was *missing* from the initial framework, rather than what was there at the outset.

Both approaches are described in more detail below.

With respect to the *context*, it was virtually impossible to recognise any pattern in the raw interview transcriptions. They had to be reduced to something more manageable, which was done as follows:

1. List the thread of the discussion, by writing out the *questions asked* and *prompting comments inserted*, while ignoring for the moment the replies. That reduced each interview to about 20 questions/topics.
2. *Extract key quotes* from the interview transcripts, edit them - paraphrasing where the quotes were difficult to read - and reference them so that one could refer back to the original transcript.

Once that was done, the task was to read them over and over again, giving them short headings, rearranging them and looking for patterns. Finally, patterns did emerge, which were articulated and then checked against the transcripts again. Very significantly, we found again and again that, in terms of the context, *the working of all facets of the bureaucracy* was by far the major topic that was brought up. What was also particularly interesting was that the topic emerged from the detail. In other words, we discussed the specifics of what the problems were, and recorded those. It was only when we analysed those carefully and looked for patterns that the topic started to emerge. It was not something that was immediately recognisable from the detail. It was the single overarching topic emerging from the in-depth interviews that appeared to link the problem in the *global* sense (i.e. good progress in terms of policy and knowledge about water services, but less satisfactory delivery and sustainability) to the *specifics* of the problems that confronted the individuals.

With respect to the *competencies*, an initial framework in the form of a draft competency table compiled from the literature provided a sound starting point. Key quotes from the in-depth interviews were coded and classified according to the draft competency table, and integrated with the literature in a draft report. Repeated interrogation of the in-depth interview text, the draft competency table and the literature produced the final competency table.

While significant progress was made in establishing a methodology and an initial understanding of knowledge uptake for developmental water services, several areas could not be fully resolved within the study. These were identified for possible further work.

4.5 Abbreviated postal/telephonic survey

Only when the report was in draft final form - based on the 5 in-depth interviews - with the draft conclusions settled, was it possible to start undertaking the abbreviated postal/telephonic survey. The main conclusions were put in the form of nominally 15 brief statements under 3 categories: (a) Developmental water services; (b) Competencies; (c) Learning styles (See Appendix C: C1 - Full Questionnaire (short)). The survey in the end was essentially a much abbreviated and edited version of the in-depth interviews. Two versions of the competency statements were developed: (a) a short version (with a total of 6 statements and a further 6 sub-statements) (See p.C2 of Appendix C: C1 - Full Questionnaire (short)); (b) long version (with a total of 27 statements, but no sub-statements) (See Appendix C: C2 - Competency questionnaire (long)). The long version was essentially a polished version of the full in-depth interview competency questionnaire. Either version could be used, depending on how much time the interviewee could afford to spend. The advantage of the long version is that it would permit comparison with the results of from the in-depth interviews.

The first of the abbreviated surveys was carried out face-to-face; and in practice it became virtually another in-depth interview. The reason for this was that it was difficult to convert the key conclusions into a few short statements. The topic is complex. The terminology required explanation, as did the aims, background and motivation for the investigation. In addition to that, there was considerable value to the project in 'picking the interviewee's brains', and in using the questionnaire as a prompt for discussion rather than place too much emphasis on the questionnaire as an end in itself. The major difference between the initial in-depth interviews and

these abbreviated follow-on surveys/interviews was that the preliminary findings were by this time more clearly and succinctly stated, having also homed in on a smaller number of priority issues. What the preparation of the abbreviated survey questionnaire therefore *did* do was to further crystallise the researchers' thought around the key conclusions of the investigation.

In order for the abbreviated surveys to check the wider validity of the in-depth interviews, it was necessary to use interviewees who were representative of technical professionals and high-level decision-makers close to the political/technical interface. This simply raised the earlier problem of access all over again: There are very few of these individuals in the country, and they are difficult to gain access to. Consequently, we found that it required almost as much effort to gain access to individuals for the abbreviated survey as it did for the in-depth interviews. What we therefore did was to concentrate on colleagues whom we knew better (to reduce the difficulty of access), thereby accepting lower representivity for ease of access.

The findings of the abbreviated surveys substantially confirmed the findings of the in-depth interviews, gave greater confidence in the earlier findings, and added a number of additional supporting insights.

4.6 Conclusions

1. In summary, the methodology consisted of two primary research strategies:
 - (a) a *review of the literature* on the topics of (i) developmental water services provision; and (ii) knowledge uptake and related factors, both individually and in combination.
 - (b) *in-depth case studies in the form of interviews and interactions* with 5 technical professionals and high-level decision-makers in the sector in urban/ peri-urban areas. The individuals interviewed were: (i) Councillor (political); (ii) Senior Manager (managerial); (iii) Technical Manager (managerial/technical); (iv) Social Consultant (managerial/social); Technical Consultant (managerial/technical). There was a mix of race and gender in the interviewees. The interviewees came from several different organisations. And care has been taken to protect the identities of the interviewees (e.g. in any quotes of interviewees, we have used 'he'/'his' throughout so as not to give an indication of the gender of the individual).
2. Two secondary research strategies were employed to support the primary research strategies:
 - (a) The in-depth case studies were preceded by *observation of typical institutional arrangements and decision-making processes* mainly in local government, which (i) provided further insight into the nature of developmental water services, and (ii) enabled the researchers to identify and obtain access to the *context* within which individuals were operating, as well as to identify appropriate and representative *individuals* for the in-depth case studies.
 - (b) The in-depth case studies were then followed by an *abbreviated postal/telephonic survey* of knowledge uptake by technical professionals/decision-makers across the sector, including a further 4 individuals and consisting of about 10-15 questions, to obtain a slightly broader sample of views on the key issues

- identified within the in-depth case studies. (In practice, the abbreviated survey tended towards a number of additional in-depth interviews - albeit abbreviated).
3. The investigation focused on the individual, and explored the uptake - meaning the acquisition, comprehension and application in context - of knowledge on developmental water services.
 4. The sequence in which these components were explored was as follows:
 - (a) The investigation started with a literature review of *knowledge/information* on developmental water services.
 - (b) This was followed by a literature review of knowledge uptake by the *individual*.
 - (c) However, in investigating the *individual*, it was found that one could not make sense of the required characteristics of the individual without also investigating the *context* in which the individual was operating.
 - (d) Investigation of the individual and context in turn led back to a re-examination of the *knowledge* - raising questions as to whether it was appropriate to the *context* (and to the *individual*).
 5. The most critical methodological issue about the literature reviews was the importance of continually referring back to and reassessing the literature as the research proceeded to the in-depth case studies.
 6. Gaining access to the context and to the individuals was a progression rather than an event, which started long before any formal application for an interview, requiring involvement by the researchers in a range of initiatives at a relatively high level over an extended period of time.
 7. The in-depth interviews were substantial, lasting about 2 hours each (+/- ¼ hour).
 8. It was particularly useful to have the third party perspective of the support consultants, who could express opinions of both political and technical groups, in addition to the opinions expressed by the political and technical groups of one another.
 9. Two different approaches were used to extract key findings from the in-depth interviews:
 - (a) investigation of the *context* required a search for a pattern, not knowing initially what one was searching for. The interviews were reduced to threads of discussion, key quotes were extracted, grouped and then labelled. Finally, a *pattern or theme did emerge from the detail* (in the form of the characteristics of 'developmental water services' - described elsewhere);
 - (b) with respect to the *competencies*, a draft competency table compiled from the literature provided an initial framework according to which extracts from the in-depth interviews could be classified and coded. However, it was in recognising what was *not* in the draft competency table (in the form of the competency of 'active listening'), rather than in matching extracts to what *was* in the draft competency table, that produced a key finding in this section of the work.
 10. Access to individuals for the abbreviated postal/telephonic surveys proved almost as difficult as for the in-depth interviews. We therefore concentrated on colleagues that we knew better to reduce the difficulty of access, thereby accepting lower representivity for ease of access. Furthermore, the complexity of the topic made it difficult to reduce the key conclusions into a few short statements for presenting to participants in questionnaire form. The terminology required explanation, as did the aims, background and motivation for the project. It proved more useful to use the questionnaire as a prompt for discussion rather than place too much emphasis on the questionnaire itself.

5 CONCLUSIONS and RECOMMENDATIONS

5.1 Conclusions

Restatement of study aims:

The study aims were as follows:

1. To *review the literature* on the topics of (a) developmental water services provision; and (b) knowledge uptake and related factors, both individually and in combination.
2. To develop a *methodology* to identify how uptake of knowledge by technical professionals and decision-makers in developmental service provision in the water sector is taking place in practice.
3. To make an *initial assessment* of how knowledge uptake (as described above) is in fact taking place in practice, and to propose *strategies to improve this*.

The core question of the study was stated as follows: "Assuming that there is good information available and accessible on the topic of developmental water services, why are individual practitioners at the higher levels not acquiring, comprehending and applying that knowledge better, as evidenced by persistent service delivery backlogs and poor sustainability?"

The question really has three parts to it:

1. Is there (as assumed) good information available and accessible on the topic of developmental water services?
2. If so, is there a mismatch between knowledge available in the literature and knowledge taken up by individuals?
3. And if there is a mismatch, why is the knowledge available in the literature not better taken up by individuals?

A key objective of the study was to understand better what the problems were confronting individual technical professionals and decision-makers, and to make connections - if there were any to be made - between the problem in the *global* sense (of the sector having made good progress in terms of policy etc., but having performed less well in terms of delivery and sustainability) and the specifics of the problems confronting *individuals*.

Study conclusions were as follows:

Knowledge uptake and context:

1. A key finding of the study is that for effective provision of water services within a developmental context, there is a close interrelationship between the three components of: (a) knowledge/information (on developmental water services); (b) context; and (c) individual; and that it is difficult to address any one of the three components without reference to the other two.
2. The investigation focused on the individual, and explored the uptake - meaning the acquisition, comprehension and application in context - of knowledge on developmental water services.
3. The sequence in which these components were explored was as follows:
 - (a) The investigation started with a literature review of *knowledge/information* on

- developmental water services.
- (b) This was followed by a literature review of knowledge uptake by the *individual*.
 - (c) However, in investigating the *individual*, it was found that one could not make sense of the required characteristics of the individual without also investigating the *context* in which the individual was operating.
 - (d) Investigation of the individual and context in turn led back to a re-examination of the *knowledge* - raising questions as to whether it was appropriate to the *context* (and to the *individual*).
4. Within the study, *knowledge* and *context* are addressed under the heading on developmental water services. *Individual* characteristics are addressed under the heading of competencies.
 5. One does not (and cannot really) measure directly what knowledge is taken up by an individual in the sense of what is acquired and comprehended by the brain; nor is it particularly important. Rather, as evidence that knowledge has been taken up, one measures what the individual can *do* with that knowledge. Knowledge uptake is therefore demonstrated through competence.
 6. Knowledge must be visible and used in practice for it to be considered taken up by an individual. Consequently, knowledge uptake is best explored by considering those competencies that are observable in the decisions, discussions and actions of technical professionals and decision-makers. The *methodology* which has been developed in this study is one which enables those observations to be made.

Methodology:

7. The methodology consisted of two primary research strategies:
 - (a) a *review of the literature* on the topics of (i) developmental water services provision; and (ii) knowledge uptake and related factors, both individually and in combination.
 - (b) *in-depth case studies in the form of interviews and interactions* with 5 technical professionals and high-level decision-makers in the sector in urban/ peri-urban areas.

The individuals interviewed were: (i) Councillor (political); (ii) Senior Manager (managerial); (iii) Technical Manager (managerial/technical); (iv) Social Consultant (managerial/social); Technical Consultant (managerial/technical). There was a mix of race and gender in the interviewees. The interviewees came from several different organisations. And care has been taken to protect the identities of the interviewees (e.g. in any quotes of interviewees, we have used 'he'/'his' throughout so as not to give an indication of the gender of the individual).

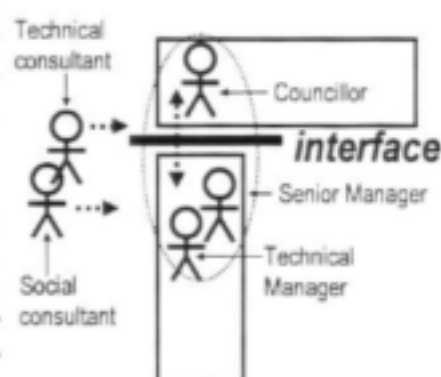


FIGURE 5.1:
INDIVIDUALS INTERVIEWED

8. Two secondary research strategies were employed to support the primary research strategies:
 - (a) The in-depth case studies were preceded by *observation of typical institutional arrangements and decision-making processes* mainly in local government, which
 - (i) provided further insight into the nature of developmental water services, and
 - (ii) enabled the researchers to identify and obtain access to the *context* within which individuals were operating, as well as to appropriate and representative *individuals* for the in-depth case studies.
 - (b) The in-depth case studies were then followed by an *abbreviated postal/telephonic survey* of knowledge uptake by technical professionals/decision-makers across the sector, including a further 4 individuals and consisting of about 10-15 questions, to obtain a slightly broader sample of views on the key issues identified within the in-depth case studies. (In practice, the abbreviated survey tended towards a number of additional in-depth interviews - albeit abbreviated).

Context in developmental water services:

9. There *is* a lot of information readily available in the sector on the provision of water services to meet developmental objectives (included in Appendix A). This information emphasises poor communities in which a range of factors other than purely technical factors are addressed.
10. What appears to be weak or missing is information on how to apply this information in context; and that context is the bureaucracy consisting of a combination of political and technical disciplines.
11. **Developmental water services** was defined as 'the provision of water services to meet developmental objectives, with an emphasis on poor communities, in which a range of factors other than purely technical factors are addressed'. A key finding of the study was the identification of a further major aspect of developmental water services as 'a combination of political and technical disciplines in a unified approach, consisting of:
 - (a) Implementation of services on the ground carried out by technical professionals (in different fields such as engineering, health, housing etc., often arranged institutionally into departments along those lines);
 - (b) decisions, trade-offs and resource allocations (within limited resources, to meet developmental objectives) carried out by politicians;
 and the institutionalisation of this, or translation into the bureaucracy'.

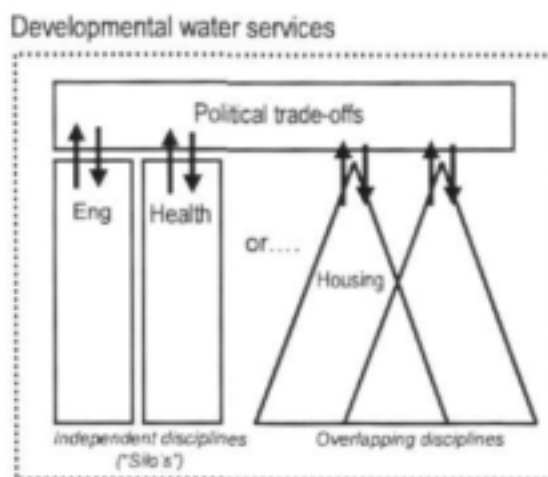


FIGURE 5.2:
SUGGESTED DIAGRAMMATIC
REPRESENTATION OF
DEVELOPMENTAL WATER SERVICES

12. As to whether there is literature on these newly identified contextual aspects of developmental water services, the answer is that there is some literature on individual elements, such as:
 - (a) trade-offs;
 - (b) different disciplines (particularly political and technical/engineering);
 - (c) different disciplines asking different types of question;
 - (d) formalisation of arrangements in the workings of the bureaucracy.
 ...but that it is more dispersed and limited than the technical literature, and is therefore not readily available and accessible to the water services community.
13. The in-depth interviews overwhelmingly supported the notion that developmental water services is 'a combination of political and technical disciplines in a unified approach, and the translation of this into the bureaucracy' (as described above). From the comments by interviewees on the context within which they operate, a *simple preliminary framework* was constructed to describe the key elements and characteristics of the workings of the bureaucracy as it applied to developmental water services. This framework consisted of two main *categories*, with a third category applying generally to both of them, and a number of sub-themes within each category:
 - (a) *Interactions between politicians and officials/technical professionals - nominally 'down the hierarchy' from politicians to officials - involve:* (i) translation or conversion from: policyto delivery, generalto specific, abstractto concrete, purposeto technique, and non-technical.... to technical; (ii) the bureaucratic aspect of this translation, namely delegation of authority (and reporting in reverse), and allocation of resources, specifically budget allocations (and reporting on budget expenditure in reverse).
 - (b) *The making of trade-offs and key decisions of principle, requiring prioritisation between different projects and different departments - nominally 'across the hierarchy' - involves:* (i) conflicting objectives, (ii) trade-offs and prioritisation within limited resources, (iii) risk and mitigation of risk.
 - (c) *General characteristics* applying to both of the above involve: (i) Communication, including communication across all interfaces and between all parties; courage/boldness in communicating the consequences of difficult choices; (ii) a team approach, and understanding the whole system, including trust and mutual support of different players, competence of different players; and (iii) the translation of these matters into the working of the bureaucracy, including: exercise of authority and fear of transgressing authority, slowness to get an interview or decision.
14. This framework - together with the supporting evidence from the in-depth interviews - is a key output of the study, providing a preliminary description of the *contextual* elements and characteristics of developmental water services.
15. Two other key observations were made in respect of the context:
 - (a) The *interfaces* between different groupings and disciplines (e.g. politicians, technical professionals, community) - and *communication across these interfaces* - are also identified as being critical.
 - (b) The major conclusion from observing institutional arrangements and decision-making processes is the *critical importance of the Mayoral Committee/Executive Mayor* in decision-making for developmental water services.
16. In summary, it was the *contextual* aspects of developmental water services, consisting of 'a combination of political and technical disciplines in a unified approach, and the

translation of this into the bureaucracy' which on the evidence of the in-depth interviews would appear to constitute the major challenge facing high-level technical professionals and decision-makers in the provision and sustainability of water services.

Competencies as evidence of knowledge uptake:

17. A framework of competencies for the developmental water services sector as a whole (including technical professionals and decision-makers), drawn from both the literature and the interviews, was constructed and is set out in Table 5.1. What is suggested is that individuals emanating from different disciplines may be stronger or weaker in particular competency areas, but that the full range of competencies should be covered by the sector as a whole. In most cases, the interviews supported, enhanced or confirmed the evidence in the literature. In some cases participants in the study stressed issues not identified in the literature.
18. A distinction needs to be drawn between *existing* competence (i.e. what individuals *can* do) and *threshold* competence (what individuals *should* be able to do). The evidence obtained from the interviews, however, did not always distinguish between the two.
19. The competencies were classified as *methodical competencies* and *social competencies or competencies of personage*. Methodical competence (MC) involves learned competence in the discipline or field. Social competence and competence of personage (SCCP) involves the capacity to work with various stakeholders in the context of work and personal attributes that are necessary to more (or most) effectively complete the work at hand.

TABLE 5.1:
COMPETENCIES FOR TECHNICAL PROFESSIONALS AND DECISION-MAKERS

Methodical competence (1)

Academic (1.1)	Practical (1.2)
Active life-long learning (1.1.1) - accessing information - lifelong professional development - initiative to continue learning	Technical know-how and skills (1.2.1) - scientific method and analysis - knowledge of contemporary issues - materials and design knowledge
Knowledgeable analysis (1.1.2) - compare information or situations - interpret & analyse, recognising the relevance of, given information - evaluate the viability of solutions - plan provision of services	Numeracy (1.2.2) - understand technical information and the basic structures of an engineered system - perform basic calculations - interpret diagrammatic information (e.g. graphs) - visualise plans & product
Technical decision-making and problem solving (1.1.3) - analyse new situations - integrate and apply diverse fields of knowledge in practice - overcome obstacles - revise processes	Information (ICT) Skills (1.2.3) - software applications - macro writing - design tools - seek, store & retrieve info as needed

Social competence and competence of personage (2)

Administrative (2.1)	Intrapersonal (2.2)	Interpersonal (2.3)
Business sense (2.1.1) - understand business processes - estimate economic costs - project management - knowledge of legislation and public policy	Listening (2.2.1) - listen to others - synthesise different perspectives - observe interactions	Teamwork (2.3.1) - respect for others - productive working relationships - function on multi-disciplinary teams
Environmental awareness (2.1.2)	Creativity / Innovation (2.2.2) - original & alternative solutions - show initiative	People management and leadership (2.3.2)
Ethical (2.1.3) - show integrity - belong to professional societies - responsible to the profession - confidentiality	Adaptable (2.2.3) - anticipate and predict change - manage change - help others adapt	Working with stakeholders (2.3.3) - client focus - understand needs of clients - negotiation - work within socio-economic context
Time management (2.1.4) - establish time frames - maintain timelines - meet deadlines	Awareness of self in context (2.2.4) - motivation - designated responsibility - multiple demands - aware of potential problems	Communication (2.3.4) - language proficiency - AV presentations - comprehension and writing - oral communication - interpersonal communication

Judgement (3)

Judgement - Judgement is fundamental to methodological, social and personal competence and impacts in every decision and sphere of influence of the individual - Judgement includes the ability to evaluate information, isolate central issues in decisions, balance competing interests and check viability of decisions
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20. Decision-making, that requires the ability to understand, interpret or analyse technical or mathematical information, in the provision of water services requires (amongst others) three levels of methodical competence, namely: (a) numeracy; (b) knowledgeable analysis; and (c) problem solving.
21. *Numeracy* (as defined here) consists of more than being able to do simple arithmetic. Numeracy includes the ability to interpret graphical information, perform basic calculations to check information and visualise what the product of drawn plans or models may look like. It also includes some basic knowledge of engineered systems. For example, a numerate person understands the basics of water flow in a reservoir or sanitation system. Without this basic numeracy, communication between technical professionals and decision-makers who are not educated in the technical aspects of the water and sanitation process is virtually impossible.
22. *Knowledgeable analysis* involves the ability to not just understand, but interpret and analyse information and use the information in decision-making, and includes the following abilities:
 - (a) compare information, looking for contradictions or reinforcement of ideas;
 - (b) determine the relevance of given information to a situation;
 - (c) interpret and analyse information seeking those aspects that are salient or central to the situation and demonstrating an understanding of the consequences of acting on the information;
 - (d) evaluate the viability of given solutions and identify potential pitfalls; and consequently;
 - (e) plan water and sanitation provision over time and space.In essence, knowledgeable analysis requires competence in working with other people's solutions rather than finding your own. In the first world literature, knowledgeable analysis is seldom discussed, but is included under other higher order methodical competencies such as problem solving.
23. *Problem solving* involves the ability to evaluate and analyse a situation with nothing given, identify and obtain appropriate methods and data and then apply the methods to solve the problem. Problem solving is a complex high order methodical competence because it requires the ability to problem pose and to evaluate the relevance, accuracy and authority of data and data sources. Problem posing also has significant links to creativity and innovation (included separately under the social competences and competences of person (SCCP)).
24. It is clear from the research that only technical professionals require high levels of *problem solving*. As a basic minimum, participants in the sector should at least be *numerate*. A lack of numeracy can have a significant impact on the quality of decision-making. It appears that most decision-makers in the water sector are numerate. However, examples of decision-makers not understanding why a water reservoir needs to be higher than the housing it services are in evidence. The level of knowledgeable analysis required to participate in the water sector is not clear. Some interviewees expressed concern at the low level of knowledgeable analysis demonstrated by decision-makers in the sector.
25. *Judgement* may be one of the most important competencies in South Africa where limited financial resources restrict the availability, choice and sustainability of services. Although it appears to the researchers that knowledgeable analysis, a business sense, active listening and working with stakeholders are key competencies in making sound judgements, the foundational basis for sound judgement remains unclear and was not a focus of this research.

26. The participants' lack of comment or attention to *actively listening* to others is in our estimation a serious shortcoming. This appears to be a shortcoming in all parties in the developmental water service sector. It may be that this limits the technical professional's capacity to work with stakeholders, a difficulty raised by consultants and decision-makers in the interviews. In addition, not listening would clearly exacerbate decision-makers' inability to acquire the knowledge necessary for analysing and may lead to some of the frustrations technical professionals experience when their advice is ignored.
27. Technical professionals struggled to work well with stakeholders and it appeared to some interviewees that technical professionals could not always discern who the stakeholders were.
28. In general participants in the sector expressed concern at the low level of written communication.
29. While competencies are clearly a key characteristic of performance of individuals, and are a major focus of this investigation, there are a number of other characteristics which may provide methods and tools for understanding and improving the performance of individuals and disciplines within the sector, including (a) Thinking style; (b) Cultural orientation; and (c) Learning style.
30. With regard to one of these aspects, namely learning style, although the sample size was small, it is particularly noteworthy that all four interviewees without hesitation indicated that they preferred visual to verbal communication. This is in line with the results of a number of international surveys on learning (Felder and Brent, 2005)¹, but in striking contrast to the format of presentation of most research outputs, including WRC reports, which are generally verbal (written) rather than visual (diagrammatic or pictorial) in format. Furthermore, evidence from a number of interactions indicates that high-level technical professionals and decision-makers in practice do not generally appear to be reading WRC reports. This provides a very brief initial indication of individual preferences for *how* knowledge might be taken up, as against *what* knowledge is - or should be - taken up (which is the primary focus of this investigation).

Developing a methodology for further research in knowledge uptake

Because the development of a methodology to assess knowledge uptake by technical professionals and decision-makers for developmental water services was a major aim of the study, further detail on methodology is included as follows:

31. The most critical methodological issue about the literature reviews was the importance of continually referring back to and reassessing the literature as the research proceeded to the in-depth case studies.
32. Gaining access to the context and to the individuals was a progression rather than an event, which started long before any formal application for an interview, requiring involvement by the researchers in a range of initiatives at a relatively high level over an extended period of time.
33. The in-depth interviews were substantial, lasting about 2 hours each (+/- ¼ hour).
34. It was particularly useful to have the third party perspective of the support consultants, who could express opinions of both political and technical groups, in addition to the opinions expressed by the political and technical groups of one another.

¹ Felder, R M and Brent, R (2005) Understanding Student Differences, *Journal of Engineering Education*, Vol. 94, No.1, pp.57-72.

35. Two different approaches were used to extract key findings from the in-depth interviews: (a) investigation of the *context* required a search for a pattern, not knowing initially what one was searching for. The interviews were reduced to threads of discussion, key quotes were extracted, grouped and then labelled. Finally, a *pattern or theme did emerge from the detail* (in the form of the characteristics of 'developmental water services' - described elsewhere); (b) with respect to the *competencies*, a draft competency table compiled from the literature provided an initial framework according to which extracts from the in-depth interviews could be classified and coded. However, it was in recognising what was *not* in the draft competency table (in the form of the competency of 'active listening'), rather than in matching extracts to what *was* in the draft competency table, that produced a key finding in this section of the work.
36. Access to individuals for the abbreviated postal/telephonic surveys proved almost as difficult as for the in-depth interviews. We therefore concentrated on colleagues that we knew better to reduce the difficulty of access, thereby accepting lower representivity for ease of access. Furthermore, the complexity of the topic made it difficult to reduce the key conclusions into a few short statements for presenting to participants in questionnaire form. The terminology required explanation, as did the aims, background and motivation for the project. It proved more useful to use the questionnaire as a prompt for discussion rather than place too much emphasis on the questionnaire itself.
37. With respect to the third aim, the project did *not* - at this stage - attempt to propose *strategies to improve how knowledge uptake is taking place in practice*. It is considered to be too early in our understanding of the topic to do so.

New knowledge contributed by the project

In summary the project contributed several new insights as follows:

1. The study developed and documented an exploratory methodology based primarily on in-depth interviews which enabled the collection of evidence on knowledge, context and individual competencies with respect to developmental water services.
2. The study established that for effective provision of water services within a developmental context, there is a close relationship between the three components of (a) knowledge/information (on developmental water services); (b) context; and (c) individual; and that it is difficult to address any one of the three components without reference to the other two.
3. The study established a number of simple preliminary frameworks as follows:
 - (a) A framework to describe the key elements and characteristics of the workings of the bureaucracy as applied to developmental water services - effectively the contextual component of developmental water services.
 - (b) A framework of individual competencies for the developmental water services sector as a whole (including both technical professionals and decision-makers).

5.2 Recommendations

Being an exploratory study, the primary recommendations are for further work.

Recommendations for further research:

1. *Repeat the investigation* - i.e. literature review and in-depth interviews (possibly jettisoning the abbreviated surveys) - but *broader and deeper*.
2. Investigate the *political* dimension of 'developmental water services', and what it brings to 'developmental water services'.
3. Investigate the *workings of the bureaucracy*, how it may be stifling the exercise of competencies of individuals in addressing the challenges that confront the sector in the provision of developmental water services, and identify what interventions may be undertaken to rectify or improve the situation.
4. For points (1) to (3) above, an *ethnographic study method* (i.e. utilising a non-participant observer over a more extended period of time than an in-depth interview) may be utilised. Ethnography is about an outsider (researcher) making the unfamiliar events and practices of a community of practice, in this case local government offices and bureaucracies in developmental water services, familiar through observation and interviews. This involves recording and reporting activity that participants (who are too close to their business) no longer consider even noteworthy but may be a central aspect of the practice and may offer vital insight into the effective supply of services to consumers. Ethnography involves participant observation working with and alongside participants in the field.
5. Investigate the depth and nature of numeracy, knowledgeable analysis and problem solving that is displayed by and required of decision-makers, technical professionals, project managers and possibly even mid-level line management.
6. Following the above series of investigations of *what* knowledge uptake is - and ought to be - taking place, investigate *how* knowledge uptake is taking place - and *how* it might better take place.
7. Investigate *current vehicles* (formal and informal) for developing the necessary competencies for high-level decision-makers and technical professionals in developmental water services, as provisionally identified in the competency table. In particular, investigate the extent to which these competencies are developed by the time individuals exit from formal higher education institutions, as well as how these competencies are developed in practice.

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APPENDIX A - DETAILED LISTING OF MAINLY TECHNICAL LITERATURE ON DEVELOPMENTAL WATER SERVICES

The starting assumption of the investigation was a suggested definition of 'developmental water services' as 'the provision of water services, with an emphasis on poor communities, to meet developmental objectives'. From this rather rudimentary starting point, the study accessed and listed available materials on developmental water services from the following range of sources:

- A1. Curricula of tertiary level educational institutions;
- A2. Information and training materials;
- A3. Booklists and bibliographies;
- A4. Organisations and websites;
- A5. South African government policies and related documentation.

A1 Curricula of tertiary level educational institutions

The curricula of a range of institutions are given here by way of illustration:

The first is the National Community Water and Sanitation Training Institute (NCWSTI) which was established on 10 September 1996 in terms of a directive from then Minister of Water Affairs and Forestry, Prof Kader Asmal, in the White Paper on Community Water and Sanitation Policy (1994). It was established by the Minister at the University of the North, in Sovenga outside Pietersburg in the Northern Province 'in accordance with the RDP principle of equity as well as the White Paper Policy emphasising a "shift to creating centers of expertise in the historically under resourced universities which are well-placed to address the needs of rural people around the country".' NCWSTI '...was established as a National Center of expertise and research "to address such issues as adult training and education methodology, assessment of the impact of education and training programmes, community training requirements and training contents"'. In 2001, the NCWSTI in conjunction with the University of the North, introduced the BSc Degree in Community Water Supply and Sanitation, with the first cohort of graduates completing the course at the end of 2003 (NCWSTI, 2004a).

The aim of the degree is to present '...an integrated approach to community development with a focus on Water and Sanitation which will create a group of graduates who can contribute to the achievement of sustainable development'. More specifically, this includes the following elements (NCWSTI, 2004b):

- 1. An integrated approach is taken in the provision of services;
- 2. The development of sustainable ecosystems maintenance;
- 3. The mitigation and management of potential conflict;
- 4. Food and fuel security;
- 5. The enhancement of equity (including gender equity);
- 6. Cost recovery;
- 7. Efficient and effective institutional structures;
- 8. Efficient and effective operation and maintenance;
- 9. Improved community health;
- 10. Increase in local economic activities.

A more detailed listing of the actual course modules offered is as follows (NCWSTI, 2004c):

Level 1:

1. Introduction to South Africa's water resources
2. Roles and Responsibilities
3. Basic Chemistry
4. Basic Physics
5. Financial Accounting
6. Financial Management
7. Management of Social Infrastructure I
8. Management of Social Infrastructure II
9. Management of Social Infrastructure III
10. Biology
11. Principles of Management
12. Participatory Methodologies
13. Introduction to Sanitation
14. Sanitation and Diseases
15. Basic Mathematics
16. Computer Literacy
17. Introduction to Monitoring and Evaluation
18. Environmental Management

Level 2:

1. Principles of Development of Surface Water Resources
2. Principles of Development of Groundwater Resources
3. Economics of Water
4. Sustainability
5. Planning of CWS Projects
6. Implementation of CWS projects
7. Introduction to the Water Treatment Process
8. Introduction to Wastewater Treatment Processes
9. Off-site Sanitation
10. On-site Sanitation
11. Solid Waste Management
12. Principles of design, construction, operation and maintenance I
13. Principles of design, construction, operation and maintenance II
14. Principles of design, construction, operation and maintenance III
15. Rural Development
16. Communication

Level 3:

1. Groundwater and surface water pollution and remediation
2. Project Management
3. Contract design and administration: Planning
4. Implementation of contracts
5. Introduction to statistics and applied research methods
6. Data collection and MIS
7. Project appraisal and selection
8. Gender and equity in water and sanitation
9. Human resources management I
10. Human resources management II

11. Local governance
12. SMME I
13. SMME II
14. Field operation: Mini dissertation Community WS.

A second degree programme, but at the postgraduate rather than the undergraduate level is the MBA in Water Management offered by the University of Kwazulu-Natal (Pietermaritzburg Campus). The programme '...combines instruction in general management, specialised tuition in water management, and a research dissertation on a project related to water management. The programme is targeted at people developing a management career in the water field in either the public or private sectors'. (University of Kwazulu-Natal, 2004).

The first half of the programme involves the completion of a Post Graduate Diploma in Management, consisting of the following courses:

1. The Business Environment
2. Accountancy for Managers
3. Operations Management
4. Business Statistics
5. Business Law
6. Management Finance
7. Management of the Human Resource
8. Marketing Management

The second half of the programme consists of the water management modules and a research report in one of the modules as follows:

1. Strategic Management
2. Economics of Water Management
3. Science, Engineering and Technology of Water Management
4. Water Information Systems
5. Water Law
6. Policy and Governance
7. Water Authority Management Project

The programme involves inputs from a range of University units including:

1. School of Business
2. Centre of Environment and Development
3. Institute of Natural Resources
4. School of Bioresource Engineering and Environmental Hydrology
5. Pollution Research Group
6. Centre for Government and Policy
7. School of Law

MBA programmes both internationally and in South Africa tend to follow a similar format, consisting of the following 9 disciplines; and while the terminology and grouping of modules may vary from programme to programme, the disciplines remain essentially the same. (Silbiger, 1999: p.xi-xii, xv):

1. Marketing
2. Ethics

3. Accounting
4. Organizational Behaviour
5. Quantitative Analysis
6. Finance
7. Operations
8. Economics
9. Strategy
10. A range of more minor topics, including Research, Public Speaking, Negotiating, International Business and Business Law.

The above programmes tend to have a private sector focus. The University of the Witwatersrand has chosen to offer a 'public sector equivalent' of the MBA through its School of Public and Development Management (P&DM), which it calls the Masters in Management - MM (P&DM).

A more detailed rationale for the MM programme is described as follows: 'Top class MBAs provide participants with a critical perspective on the dilemmas of strategy, management and organisation in a complex and continuously changing world. An MBA however, does not provide an in-depth focus on the interplay between public, private and not for profit sectors that is central to the MM. ... The MM recognises the need to set policy making and management in the wider context of democratic governance and public policy. ... It develops managers who are able to contribute to improved service delivery within a democratic, accountable and responsive public and development environment. ... This programme is designed for experienced policy makers and managers across all parts of the public sector including: The civil service, Local government, Health service, Education, Police. The programme is also relevant to partnership and larger voluntary organisations, and in regulated industries' (University of the Witwatersrand, 2004).

They suggest that there are 12 critical competencies for effective performance, which include:

1. strategic capability and leadership
2. policy formulation and implementation
3. programme and project management
4. financial management
5. change management
6. knowledge management and empowerment
7. client orientation and customer focus
8. communication, honesty and integrity

The programme consists of 6 Fundamental courses, which must be completed before proceeding to the 5 Core courses, and then on to the 4 Elective courses, and finally the research project and report:

Fundamental courses (6):

1. Information Management and Communications
2. Economics and Public Finance
3. Governance and Development
4. Managing Strategy and Change
5. Principles of Service Delivery
6. Public Policy

Core Courses (5):

1. Development Management
2. Knowledge Management
3. Managing People and Organisations
4. Policy Management and Evaluation
5. Strategy and Leadership

Electives (4 from the following streams):

1. Development Management
2. Economic Policy and Public Finance
3. Human Resource Management and Development
4. Information Communication and Management
5. Local Government and Development
6. Managing Change and Delivery
7. Policy, Planning and Evaluation

In terms of programmes from other countries, three are included: Leeds University, WEDC of Loughborough University and IHE, Delft. These particular courses are of a more technical nature than the Management courses above.

The *School of Civil Engineering at the University of Leeds* offers an *MSc(Eng) in Environmental Engineering and Project Management*. Within the programme, there are three individual themes (University of Leeds, 2004):

1. *Environmental Engineering and Project Management*, which is intended for those '... who find themselves in management positions with little knowledge or experience of the management techniques necessary to manage the range of projects for which they have responsibilities. In addition it is appropriate for those people who have a background in management but feel that they lack up to date technical knowledge'
2. *Public Health Engineering*, which is intended for those '...who are currently employed by the UK Water PLC's, Regulators, Consultants, Industry or other relevant bodies. It covers in some detail the collection and treatment of waters and wastewaters from primarily a UK/European perspective. The relevant legislation relating to potable and wastewaters is described and the structure, management and regulation of the UK Water Industry are outlined in detail. Students are also given the opportunity to familiarise themselves with the technical aspects of both water treatment and distribution and wastewater collection, treatment and disposal in the context of the AMP needs of the Water PLC's...'
3. *Tropical Public Health Engineering*, which '...is aimed at those developing countries for which the most important priorities are the provision of low-cost water supplies and sanitation. It is concerned more with the health implications of water-borne infections and with those technologies which are best able to reduce the risks from excreta-related diseases whilst also minimising the environmental impact of waste discharges. It considers not only the development and sociological aspects of the provision of water supply and sanitation but also the necessary project management and financial requirements of large capital projects'.

All courses require students to complete 180 credits for the degree, which implies 8 course modules (of 15 credits each) and a dissertation (of 60 credits). There are **4 Compulsory modules**:

1. International Environmental Impact Assessment
2. Project Management
3. Advanced Project Management
4. Wastewater Engineering

...and a further **4 Optional modules** to be selected from the following list:

1. Waste Policy and Evaluation
2. Environmental Law
3. Water Resource Management
4. Waste Minimisation and Recycling
5. Landfill Process and Design
6. Industrial Wastes
7. Solid Waste Management
8. Tropical Public Health
9. Tropical Water Engineering
10. Natural Wastewater Treatment
11. Sanitary Microbiology.

All three of the individual themes appear - with different emphases - to have applicability to the field of developmental water services provision.

A second degree programme is that of *UNESCO-IHE, Delft, Netherlands*, which offers an *International Masters Programme in Water Management* (UNESCO-IHE, 2004). The programme aims '... at educating professionals from a wide range of backgrounds in the integrated management of water and environmental resources, involving the physical, institutional, economic, social, legal and environmental aspects. In these aspects, the quantity, quality, origin, occurrence, use and availability of the water resources are considered as being part of one undivided system. Management implies policy development, planning and design of strategies for sustainable development, allocation of scarce resources, implementation of strategies, and the operation of agencies and utilities'.

Learning objectives for the programme are that successful participants are:

1. Familiar with the latest debates, insights, concepts and tools in Integrated Water Resources Management;
2. Able to balance interests among conflicting functions and water uses in the framework of policy objectives and constraints;
3. Able to design adequate institutional frameworks for water management at different levels;
4. Possessing skills for operational management of water agencies or utilities;
5. Able to present, orally and in written form, in a systematic and scientifically sound manner;
6. Possessing skills for individual research;
7. Able to work and communicate in a multi-disciplinary and multi-cultural environment.

There are three specialisations within the programme:

1. Water Resources Management

2. Water Services Management
3. Water Quality Management

The Water Services Management specialisation appears to be option that most closely approximates developmental water services provision. In addition to outcomes of the general programme, the further specific outcomes of the specialisation are that successful participants will be able to:

1. Use basic skills and tools necessary for the management of water sector utilities;
2. Design appropriate operations and maintenance routines for water sector utilities;
3. Implement sound financial management of a water services organisation;
4. Assess institutional arrangements in the water supply and sanitation sector;
5. Analyse water supply and sanitation organisations and develop change management plans for these organisations.

A2 Information and training materials

One of the first major international thrusts in the development of research/educational materials for water and sanitation was a series of research publications produced by the World Bank under the guidance of John Kalbermatten at the start of the Water Decade. A listing of the 12-volume series entitled *'Appropriate Technologies for Water Supply and Sanitation'* is as follows (Kalbermatten et al., 1980):

- Vol. 1 *Technical and Economic Options* by John M. Kalbermatten, DeAnne S Julius and Charles G. Gunnerson [a condensation of *Appropriate Sanitation Alternatives: A Technical and Economic Appraisal*]
- Vol. 2 *A Planner's Guide* by John M. Kalbermatten, DeAnne S. Julius, Charles G. Gunnerson and D. Duncan Mara [a condensation of *Appropriate Sanitation Alternatives: A Technical and Economic Appraisal*]
- Vol. 3 *Health Aspects of Excreta and Sullage Management - A State-of-the Art Review* by Richard G. Feachem, David J. Bradley, Hemda Garelick and D. Duncan Mara [a condensation of *Sanitation and Disease: Health Aspects of Excreta and Wastewater Management*]
- Vol. 4 *Low-Cost Technology Options for Sanitation - A State-of-the-Art Review and Annotated Bibliography* by Witold Rybczynski, Chongrak Polprasert and Michael McGarry.
- Vol. 5 *Sociocultural Aspects of Water Supply and Excreta Disposal* by Mary Elmendorf and Patricia Buckles.
- Vol. 6 *Country Studies in Sanitation Alternatives* by Richard A. Kuhlthau
- Vol. 7 *Alternative Sanitation Technologies for Urban Areas in Africa* by Richard G Feachem, D. Duncan Mara and Kenneth O. Iwugo
- Vol. 8 *Seven Case Studies of Rural and Urban Fringe Areas in Latin America* by Mary Elmendorf
- Vol. 9 *Design of Low-Cost Water Distribution Systems*, Section 1 by Donald T. Lauria, Peter J. Kolsky and Richard N. Middleton; Section 2 by Keith Demke and Donald T. Lauria; and Section 3 by Paul B. Hebert
- Vol.10 *Night-Soil Composting* by H I Shuval, Charles G Gunnerson and DeAnne S Julius
- Vol.11 *Sanitation Field Manual* by John M. Kalbermatten, DeAnne S. Julius, Charles G.

A particularly comprehensive set of information and training materials was a World Bank-executed UNDP project of the mid-1980s, which was conceived and directed by John Kalbermatten, and called the '*Information and Training Program in Low-Cost Water Supply and Sanitation*' (World Bank, 1986). A listing of the training modules is as follows (World Bank, 1986):

Section 1. Introduction to Low-Cost Water Supply and Sanitation

- 1.1 Introduction
 - a. Water, Wastes and Health
 - b. Alternative Technologies
 - c. Project Planning and Community Health

Section 2. Management and Community Participation

- 2.1 Project Preparation and Implementation
 - a. Project Identification and Preparation
 - b. Project Approval, Implementation, Operation and Evaluation
 - c. Developing a Program
- 2.2 Institutional and Financial Aspects
 - a. Institutional Aspects
 - b. Financial Aspects
 - c. Human Resources Development
- 2.3 Economic Appraisal of Projects
 - a. Time Value of Money
 - b. Economic Appraisal
- 2.4 User Participation
 - a. The Importance of User Participation
 - b. User Assessment and Feasibility
 - c. Implementing the Use Participation Program

Section 3. Health and Hygiene

- 3.1 Health Aspects of Water Supply and Sanitation
 - a. Disease Description
 - b. Transmission Routes
 - c. Disease Control
- 3.2 Hygiene Education
 - a. The Team Effort
 - b. Understanding the Community
 - c. Developing the Program for Change

Section 4. Water Supply

- 4.1 Rainwater Roof Catchment Systems
 - a. Feasibility
 - b. Design and Construction
 - c. North-East Thailand: Rainwater Catchment

- 4.2 Wells and Handpumps
 - a. Introduction
 - b. Construction of Wells and Boreholes
 - c. Handpumps
 - d. Livulezi, Malawi: Wells and Handpumps
- 4.3 Gravity-Flow Water Supply
 - a. Introduction
 - b. Construction
 - c. Malawi: Gravity-Flow Water Supply
- 4.4 Water Distribution Network
 - a. Introduction to Water Distribution Systems
 - b. Problems with Conventional Design Methods
- 4.5 Water Treatment
 - a. Low-Cost Rapid Filtration Plants for Water Treatment
 - b. Rural Water Supply Treatment

Section 5. Sanitation

- 5.1 On-Site Sanitation
 - a. Ventilated Improved Pit Latrines
 - b. Pour-Flush Toilets
 - c. Other Sanitation Technologies
 - d. Baldia, Pakistan: Urban Sanitation
- 5.2 Waterborne Sanitation
 - a. Septic Tanks
 - b. Small bore Sewerage
 - c. Conventional Sewerage
- 5.3 Sanitation Technology Selection
 - a. Site Investigations
 - b. Water and Sanitation Interactions
 - c. Technology Selection and Upgrading
- 5.4 Waste Treatment and Resource Recovery
 - a. Conventional Treatment
 - b. Waste-Stabilization Ponds
 - c. Resource Recovery: Biogas/Aquaculture/Composting

Section 6. Case Studies

- 6.1 Use Participation Case Studies
 - a. Pakistan: Rural Sanitation
 - b. Guatemala: Rural Water Supply and Sanitation

Section 7. Training Information

- 7.1 Instructors' Module

Other Material Available in This Series

Decision-makers' presentation
 Community participation guidelines (text)
 Hygiene education guidelines (text)
 Training films and videocassettes (3)

Project Preparation handbook (3 volumes)

The materials were used by the International Training Network (ITN) of the UNDP/World Bank Water and Sanitation Program (WSP). In practice, however, they were found to be more suited to formal educational contexts than to practitioners (informal feedback from the 5th Africa Regional Meeting of the ITN, Kumasi, Ghana, December 1992).

The *Blue Gold Series of Field Notes and Leaflets*, produced by the Water and Sanitation Program-Africa Region (WSP-AF), independently edited by Jon Lane (formerly the Director of WaterAid), and carrying the slogan 'Building African Solutions for Water, Sanitation and Hygiene', presents a series of short case studies on "... African initiatives in water and sanitation that have worked, or have the potential to work, at a large scale, that are demonstrably sustainable, and that do not benefit from too many unique local conditions....The Field Notes and Leaflets are short enough to be easily read by busy people. They describe the work done, highlighting points of interest, problems and lessons. They are not intended to be detailed analytical papers....These Field Notes and Leaflets are intended principally for the new generation of Africa's parliamentarians, sector leaders, administrators and individuals tackling the water and sanitation challenge in Africa." A listing of topics being published or planned in the series includes the following (Lane, 2002):

1. Water and Sanitation Sector Reform in Uganda: A Government-led Transformation
2. Hygiene Promotion in Burkina Faso and Zimbabwe: New Approaches to Behaviour Change
3. Water Services in Small Towns across Africa: The Role of Small and Medium-Sized Private Enterprise
4. The National Sanitation Programme in Mozambique: Pioneering Peri-Urban Sanitation
5. Rural Piped Water Supplies in Ethiopia, Kenya and Malawi: Community Management and Sustainability
6. The Ventilated Improved Pit Latrine in Zimbabwe: How a Local Initiative Became a World-Famous Sanitation Technology
7. Rural Water Sector Reform in Ghana: A Major Change of Both Policy and Structure
8. The Strategic Sanitation Plan in Ouagadougou, Burkina Faso: A Holistic Approach to a City's Problems
9. The National Water and Sanitation Programme in South Africa: Turning the 'Right to Water' into Reality
10. Social Funds in Africa: Supporting Community Micro-Projects in Rural Water Supply.
11. The National Sanitation Programme in Lesotho: How Political Leadership Achieved Long-Term Results
12. The Mvula Trust in South Africa: An Independent Partner to Government
13. Hand Washing in Ghana: New Co-operation with the Private Sector
14. Urban Water Supply Innovations in Abidjan, Cote d'Ivoire: How Cross-Subsidies Help the Poor
15. Upgraded Family Wells in Zimbabwe: Household Level Water Supplies for Multiple Uses
16. NGOs across Africa: A Range of Different Roles
17. Water Services for the Poor in Durban, South Africa: Technologies and Tariffs.

The Field Notes and Leaflets are easily downloadable from the Internet in Adobe Acrobat format, although the photographs in the digital versions have rather low resolution.

A3 Booklists and bibliographies

Various organisations working in the sector have published lists of books and reports in the sector. The Swiss-based SKAT Foundation has produced a list of exactly what it says - '20 Basic Books: Drinking Water Supply and Environmental Sanitation', several of which are available by direct download from the Internet. The books are aimed "... primarily at planning and executing technicians and engineers across a wide spectrum of institutions." The books, grouped under 5 categories and containing brief summaries (not reproduced here), are listed as follows (SKAT Foundation, 2004):

General Literature on Water Supply and Sanitation

1. Batteson, H, Davey, K and Shaw, R (1998) *Guidance Manual on Water Supply and Sanitation Programmes*, WEDC, Loughborough, UK, 338pp. (downloadable)

Health, Hygiene Behaviour, Education and Promotion

2. Cairncross, S and Feachem, R G (1993) *Environmental Health Engineering in the Tropics: An Introductory Text* (2nd edition), Wiley, 306pp.
3. WHO (1993 to 1998) *Guidelines for Drinking-Water Quality* (2nd edition) , WHO:
 - Vol.1 - Recommendations (1993) 180pp.;
 - Vol.2 - Health Criteria and Other Supporting Information (1996), 973pp.;
 - Vol.3 - Drinking Water Surveillance and Control of Community Supplies (1997), 238pp.;
 - various companion addenda, released in 1998 to keep the guidelines current (downloadable)
4. Bolt, E (ed.) (1994) *Together for Water and Sanitation - Tools to Apply a Gender Approach: the Asian Experience*, Occasional Paper 24, IRC, The Hague, Netherlands.
5. Cairncross, S and Kochar, V (eds.) (1994) *Studying Hygiene Behaviour: Methods, Issues and Experiences*, Sage Publications India PV Ltd, New Delhi, India, 334pp.
6. Simpson-Hebert, M and Wood, S (eds.) (1998) *Sanitation Promotion - WSSCC Working Group on Promotion of Sanitation*, WHO, 277pp. (downloadable)

Drinking Water Supply and Treatment Technologies

7. Twort, A C, Ratnayaka, D D and Brandt, M J (2000) *Water Supply* (5th edition), IWA Publishing, London, UK, 676pp.
8. SKAT Switzerland (2000 to 2002) *Series of Manuals on Drinking Water Supply* (available in Adobe Acrobat format on CD-ROM):
 - Frolich, U (2001) *Vol.I - Management Guide*, 235pp.
 - Gachwiler, F, Wehlre, K and Christen, J (2002) *Vol.II - Engineering Guide*, about 300pp.
 - Meuli, C, Wehlre, K, Mueller, H and Pfiffner, H (2000) *Vol.III - Building Construction*, 57pp.
 - Meuli, C and Wehlre, K (2001) *Vol.IV - Spring Catchment*, 52pp.
 - Collins, C (2000) *Vol.V - Hand-Dug Shallow Wells*, 92pp.
 - Ball, P (2001) *Vol.VI - Drilled Wells*, 72pp.
 - Baumann, E (2000) *Vol.VII - Water Lifting*, 72pp.
9. Gould, J and Nissen-Petersen, E (1999) *Rainwater Catchment Systems for Domestic*

Supply, ITDG Publishing, London, 335pp.

Environmental Sanitation and Wastewater Treatment

10. Mara, D (1996) *Low-Cost Urban Sanitation*, Wiley, UK, 223pp.
11. Mara, D (ed.) (1996) *Low-Cost Sewerage*, Wiley, UK, 225pp.
12. Mara, D (1997) *Design Manual for Waste Stabilization Ponds in India*, Lagoon Technology International Ltd., Leeds UK, 125pp.
13. Lens, P, Zeeman, G and Lettinga, G (2001) *Decentralised Sanitation and Reuse - Concepts, Systems and Implementation*, IWA Publishing, UK, 650pp.
14. Esrey, S A, Gough, J, Rapaport, D, Sawyer, R, Simpson-Henert, M, Vargas, J and Winblad, E (eds.) (1998) *Ecological Sanitation*, Department of Natural Resources and the Environment, Sida, Stockholm, Sweden, 92pp. (downloadable)
15. Tayler, K, Colin, J and Parkinson, J (2000) *Strategic Planning for Municipal Sanitation - A Guide (1st edition)*, GHK Research and Training, London, UK, 250pp. (downloadable); revised and published (2003) by ITDG Publishing.

Drinking Water and Environmental Sanitation in Emergencies

16. Davis, J and Lambert, R (2002) *Engineering in Emergencies: a Practical Guide for Relief Workers* (2nd edition), IT Publications Ltd., 718pp. (available in CD-ROM)
17. Walker, P (Project Co-ordinator) (2000) *Humanitarian Charter and Minimum Standards in Disaster Response (The Sphere Project)*, Oxfam Publishing, 330pp. (downloadable as a zipped archive of Rich Text Format files)
18. Harvey, P, Baghri, S and Reed, B (2002) *Emergency Sanitation: Assessment and Programme Design*, WEDC, Loughborough, UK, 258pp. (downloadable)
19. Rozendaal, J A (1997) *Vector Control*, WHO, 412pp.

Operation and Maintenance of Infrastructure

20. Brikke, F et al. (2000) *Operation & Maintenance of Rural Water Supply and Sanitation Systems*, Resource Training Package for Managers and Planners, WHO, 292pp.

Locally, SANTAG, in an issue of its newsletter, Outlet (SANTAG, 2002), produced useful summaries of 33 WRC research reports on water and sanitation issues in South Africa.

For new research articles, the journal, *Environment and Urbanization* (2003) recently published a special issue on Water and Sanitation. Electronic copies of the papers are available for purchase through electronic publishing house, Ingenta Select. The full issue (15 journal papers, plus editorial and miscellaneous other shorter items) costs of the order of US\$35 (R200-R250). While convenient to order (if one can use a credit card over the Internet), download times can be slow for the approximately 10Mb total file size, depending on the speed of one's telephone line. The papers were published under 5 categories:

1. Meeting Needs
2. Understanding Women and Children's Needs
3. Assessing Responses
4. Water Stress and City-Regional Interactions
5. Managing Rural-Urban Interactions for Wastewater
6. The Millennium Development Goals

In order to allow the journal's main findings to reach a wider audience, a 6-page *Brief* of the full journal issue has been funded by DANIDA and DFID (Environment and Urbanization Brief, 2003). The Brief is freely available (by contrast with the journal itself), and appears to be circulated widely in Adobe Acrobat format.

A4 Organisations and websites

GHK Research and Training Ltd (2000) provides a useful section on References and Sources of Further Information in its guide on Strategic Planning for Municipal Sanitation (2000: Part C, p.C7-1 to 22). The references provided are divided according to the structure of the guide. Several of the references are repeated elsewhere above. A particularly useful addition, however, is a section on Internet Information Networks, which includes short summaries of the following categories:

Networks and Internet portals:

1. IRC Database on Water and Sanitation in Developing Countries (IRCDOC), <<http://www.irc.nl/ircdoc/>>
2. Global Applied Research Network (Garnet), <<http://www.lboro.ac.uk/garnet>>
3. N-AERUS - Network for Research on Urbanisation in the South, <<http://www.naerus.org>>
4. Forum: Habitat in Developing Countries, <<http://girotondo.oasi.asti.it/forum/welcome.htm>>

Mailing lists:

1. "SOURCE" Water and Sanitation News, <<http://www.wsscc.org/source>>
2. ID21 Development Research reporting service, <http://www.id21.org/>

Discussion groups

Mailbase (<<http://www.mailbase.ac.uk>>) offers a number of e-mail discussion groups including:

1. Water and Sanitation Applied Research
2. Pitnet Latrine Network
3. Urban Drainage
4. Urban Environmental Health
5. Wastewater Management

Key International Organizations in Water and Sanitation

1. INTERWATER Internet Gateway to Water and Sanitation Information, <<http://www.wsscc.org/interwater/index.html>>
2. Water and Sanitation Program, <<http://www.wsp.org>>
3. World Bank - Water Supply and Sanitation, <<http://www.worldbank.org>>
4. Business Partners for Development - Water and Sanitation Cluster [since changed to *Building Partnerships* for Development?], <<http://www.bpd-waterandsanitation.org>>
5. USAID Environmental Health Project (EHP), <<http://www.ehproject.org>>
6. PPIAF (Public-Private Infrastructure Advisory Facility), <<http://www.ppiaf.org>>
7. WHO (World Health Organization)

8. Global Water Partnership (GWP)
9. WSSCC (Water Supply and Sanitation Collaborative Council)
10. United Nations Environment Programme (UNEP)
11. WaterAid, <<http://www.wateraid.org.uk>>
12. International Training Network for Water and Waste Management (ITN), <<http://www.wsp.org/English/itn.html>>

A5 South African government policies and related documentation

As policy and strategy in the water and sanitation sector have been clarified and formalised, the various documents have become available.

Probably the key current document with respect to Developmental Water Services provision is the *Strategic Framework for Water Services* (DWAF, 2003), providing key policy decisions for the sector under the following headings (excluding Introduction - 1, and Conclusion - 9):

2. Sector vision, goals and targets
3. The institutional framework
4. The financial framework
5. The planning framework
6. National norms and standards
7. The regulatory framework
8. The support and monitoring framework

By setting out how things *will* be done in the sector, policy also sets out how things *will not* be done i.e. the options which have been decided *against*. In order to understand better the decisions taken, it is instructive to read the Strategic Framework in conjunction with the earlier *Issues and Options Discussion Paper* (DWAF, 2002).

Two other useful earlier documents include:

1. DWAF (2000) *Water Supply Service Levels: A Guide for Local Authorities*, November (with the purpose of assisting local government and other water service institutions to select appropriate levels of service for water provision)
2. DWAF Chief Directorate: Water Services (2001) *Free Basic Water: Guideline for Local Authorities*, prepared by Palmer Development Group for the Directorate: Interventions and Operations Support, June (one component of the support being offered by DWAF to local authorities wishing to implement a 'free basic water' policy).

A6 References

- DWAF (2002) *Towards a Water Services White Paper: Issues and Options Discussion Paper*, April.
- DWAF (2003) *Strategic Framework for Water Services*, DWAF, September
- Environment and Urbanization (2003) *Special Issue: Water and Sanitation*, Vol.15, No.2, October, 285pp.
- Environment and Urbanization Brief (2003) Water and Sanitation; what will deliver the improvements required for urban areas? Brief No.8, <<http://www.iied.org/human>>
- GHK Research and Training Ltd in association with WEDC and WSP-SA (2000) *Strategic Planning for Municipal Sanitation: A Guide*, 1st edition, WEDC, July.
- Kalbermatten, J M, Julius, DeA S and Gunnerson, C G (1980) *Appropriate Technology for Water Supply and Sanitation: A Summary of Technical and Economic Options*, Vol. 1a, World Bank, December.
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- NCWSTI (2004a) *National Community Water and Sanitation Training Institute: Company Profile*, <<http://www.nwsti.co.za/about>>, last updated 21 April 2004.
- NCWSTI (2004b) *National Community Water and Sanitation Training Institute: The BSc Degree in Community Water and Sanitation*, <<http://www.nwsti.co.za/bsc/index.html>>, last updated 2 September 2002.
- NCWSTI (2004c) *National Community Water and Sanitation Training Institute: BSc modules*, <<http://www.nwsti.co.za/bsc/modules.html>>, last updated 2 September 2002.
- Silbiger, S (1999) *The 10-Day MBA*, Piatkus.
- SANTAG (2002) *Water Research Commission Reports*, Outlet, Newsletter for SANTAG, Ed: Louise Torr, No.55, November.
- SKAT Foundation (2004) *20 Basic Books: Drinking Water Supply and Environmental Sanitation*, <<http://www.skafoundation.org/publications/htm/20BB/>>
- UNESCO-IHE (2004) *International Masters Programme in Water Management*, <<http://www.unesco-ihe.org/education/downloads/full/WSM.pdf>>
- University of Kwazulu-Natal (2004) *Masters in Business Administration Programme - in Water Management*, <<http://www.ukzn.ac.za>> (hierarchy of web pages unclear; rather search directly from the home page).
- University of Leeds (2004) *MSc(Eng) Environmental Engineering and Project Management - School of Civil Engineering*, <<http://www.leeds.ac.uk/civil/pgopps/enveng/enveng.html>>
- University of the Witwatersrand (2004) *Masters in Management Programme*, <<http://pdm.mgmt.wits.ac.za/MM-PDM.pdf>>
- World Bank (1986) *Information and Training for Low-Cost Water Supply and Sanitation: Sections 5.1: On-Site Sanitation and 5.2: Waterborne Sanitation, Participants' Notes*, World Bank.

APPENDIX B - TYPICAL CORRESPONDENCE AND SUPPORTING DOCUMENTATION FOR IN-DEPTH INTERVIEWS

B1 Initial request for appointment and brief project summary

[LETTERHEAD]

Dear

Request for appointment in connection with a Water Research Commission Research Project on Knowledge Uptake

Please may I request an appointment with yourself to speak to you in connection with a Water Research Commission research project that I am currently busy with entitled "Knowledge Uptake by Technical Professionals and Decision-makers for Developmental Water Services".

A brief description of the project is attached.

What I would like to do is:

- (a) to explain the project briefly to you;
- (b) to ask if you could assist us in referring us to appropriate people in [organisation]
- (c) to see whether you might assist us yourself - or give us some pointers - on a few matters regarding the research.

[Researchers]

KNOWLEDGE UPTAKE BY TECHNICAL PROFESSIONALS AND DECISION-MAKERS FOR DEVELOPMENTAL WATER SERVICES PROVISION

by Mark van Ryneveld and Stephen Sproule

Summary of current Water Research Commission Research project:

SUMMARY DETAILS:

Short Title: Knowledge uptake for developmental water services
Long Title: Knowledge uptake by technical professionals and decision-makers for developmental water services provision
Proposal Year: 2003
Duration: 1 April 2004 - 31 March 2005
WRC Categories: *Key Strategic Area* = KSA 3: Water Use and Waste Management; *Thrust* = Water Services: Institutional and Management Issues
WRC Research Manager: Mr Jay Bhagwan
WRC Project No: K5/1519
Budget: R180 000 (excl VAT)

RESEARCHER DETAILS:

Project Leader: Dr MB van Ryneveld
Organisation: Mark van Ryneveld
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Dr SL Sproule; BSc(Mathematics and Environmental Science), Higher Diploma in Education (cum laude), BSc(Hons)(Mathematics teaching)(cum laude), MSc(Mathematics Education)(cum laude), PhD (Mathematics Education)

MOTIVATION :

Over the past decade or so in South Africa, there has been a fundamental change in the way in which services are provided, from an approach dominated by technical factors to one which might be termed 'developmental service provision', in which a range of factors other than purely technical are addressed. This change has been acknowledged by the WRC in its own knowledge review, where it has observed that "...the sector is in transformation", pointing to a "shift in paradigm" as the challenges of integrating technical factors with other factors such as business aspects become more established (WRC, 2002: p.24,31-32). The review went on to indicate that this is a relatively new field (specifically referring to Integrated Urban Water Management) and that capacity is relatively low. The Development Bank of Southern Africa (DBSA) has also identified the low capacity in the sector and has indicated that it intends "...to establish a "knowledge institution" in the next year with the aim of "unlocking capacity" of local municipalities" (Phasiwe, 2003). However, from the teaching of several formal tertiary level courses by the researchers over several years, complemented by experience in practice it would appear that while there is fairly significant knowledge available within the research community on the change 'from technical design to developmental service provision', there appears to be insufficient uptake of this knowledge by technical professionals and decision-makers responsible for service provision (Van Ryneveld and McCutcheon, 1997). Knowledge uptake requires an active acquisition of disseminated information, the comprehension of the information and the ability of practitioners to apply the information in the field. Uptake of knowledge within the new service provision paradigm is therefore identified as a topic requiring further investigation. This project will identify factors limiting and enabling the uptake of knowledge in the sector, and through the study of international and national sectoral education trends, propose strategies for improving the uptake of knowledge in the sector by technical professionals and decision-makers.

AIMS:

1. To review the literature on the topics of (a) developmental water services provision ; and (b) knowledge uptake and related factors; both individually and in combination.
2. To develop a methodology to identify how uptake of knowledge by technical professionals and

3. decision-makers in developmental service provision in the water sector is taking place in practice To make an *initial assessment* of how knowledge uptake (as described above) is in fact taking place in practice, and to *propose strategies to improve this*.

METHODOLOGY:

- (a) Procedures and experimental techniques to be applied: The research will take the form of:
- (a) *literature review* of both uptake of knowledge and related factors and (more briefly) of developmental service provision;
 - (b) *brief sector survey*, based on easily accessible statistical data on number of personnel and formal skills levels for different institutions in the sector, in order to identify appropriate and representative individuals for the survey and detailed case studies;
 - (c) preparation of *summary findings of literature review* for dissemination to those involved in detailed case studies (in addition to general users of this research);
 - (d) *abbreviated survey of knowledge uptake* by technical professionals/decision-makers across the sector, by means of a postal questionnaire sent to about 30 individuals, consisting of about 10-20 questions.
 - (e) *in-depth case studies* in the form of interviews and interactions with technical professionals and decision-makers (between four and six sets of interviews, as resources allow, covering a representative range of technical professionals and decision-makers in the sector in both urban and peri-urban areas);
 - (f) *Research report*, combining all elements of the project, as well as a *short (nominally 10 page) article* for publication in a widely-read magazine or journal, summarizing the key findings and recommendations of the project, and targeted at key decision-makers.
- (b) Variables that can affect the results and how they will be monitored and accounted for: Probably the most crucial variable that can affect the results - and the success of the research project - is the access to and co-operation of individual technical professionals and decision-makers. Steps taken to address this matter in the research project include:
- (a) *offering of early outcomes of literature review* to personnel who may wish to participate in the case studies;
 - (b) *specific funding for involvement of personnel*. Both government and private sector personnel are generally under extreme time pressure. It is considered that funding for personnel - or their institutions - in both cases will assist in this matter;
 - (c) *Explicit provision for individuals who choose to participate in the case studies to benefit personally from the research*, in their personal development (through general information, materials and interaction designed specifically for the individual).
- (c) Other information:
- (a) *Where the research will be carried out:* The nature of the factors limiting and enabling knowledge uptake in the sector are considered to be the same within urban, peri-urban and rural areas. The factors are considered to differ in degree of limitation rather than in their nature. This project will focus in its case studies on urban and peri-urban areas nominally within Gauteng Province.

REFERENCES:

- Phasiwe, Khulu (2003) *Article:* Development Bank worried about backlog, Business Day, Fri 11 July, p.3
- Van Ryneveld, M B and McCutcheon, R T (1997) Teaching of development engineering at undergraduate level in the civil engineering degree at the University of the Witwatersrand, Johannesburg, *8th Annual Congress of the South African Institution of Civil Engineering, "Magnum Opus"*, Eskom Conference Centre, Midrand, 17-18 April.
- WRC (2002) *Knowledge Review 2001/2002*, WRC.

Mark van Ryneveld

Summary dated 26 July 2004; proposal finalised 9 Feb 2004

ANNEXURE: ABBREVIATED CV's OF RESEARCH TEAM

Mark van Ryneveld

(1) Personal details: (1.1) Full names: Mark Berrange van Ryneveld (1.2) Date of birth: 13 October 1957 (1.3) Nationality: South African (2) Employment history: (2.1) Jul 2001-present: Independent professional, operating primarily in the area of research, planning and capacity building in infrastructure provision (with particular specialist skills in water and sanitation); (2.2) Jul 1989-Jul 2001: Faculty member (Lecturer): School of Civil and Environmental Engineering, University of the Witwatersrand, Johannesburg; (2.3) Jan 1981-Jun 1989: Civil Engineer, Hawkins, Hawkins and Osborn Consulting Engineers, Cape Town (1981-1982: Assistant Resident Engineer; 1982-1989: Design Engineer). (3) Academic qualifications, professional registrations+memberships and awards: (3.1) Academic qualifications: ●BSc(Eng)(Civil) University of Cape Town, 1980; ●MSc(Eng) Dissertation examined and passed, but degree not received; converted registration directly to PhD, Univ of the Witwatersrand, 1995; ●PhD University of the Witwatersrand (Title: 'Design of civil engineering facilities for developing communities, with particular reference to water supply and sanitation provision in the urban areas of South Africa'), 2002. (3.2) Professional Registrations: ●Professional Engineer (PrEng) (South African), 1988; ●Chartered Engineer (CEng) (British), 1987. (4) Professional and academic experience, consultancies and appraisal of the work of others: (4.1) Professional: 1981-1982: Assistant Resident Engineer, Hawkins, Hawkins and Osborn Consulting Engineers, Cape Town; 1982-1989: Design Engineer, Hawkins, Hawkins and Osborn Consulting Engineers, Cape Town. Experience included work both in the design office and on site on a range of structural and civil projects in the Western Cape, Namaqualand and previous states of Ciskei and Transkei in the Eastern Cape, South Africa (4.2) Contract research/consultancies: Contract research and consultancies have been in the fields of costs and affordability of water and sanitation systems as well as the environmental impact of sanitation systems (including assignment of cost to that impact), moving more recently into broader infrastructure provision, environmental and skills development issues (4.3) Academic experience: Jul 1989-Jul 2001: Lecturer, School of Civil and Environmental Engineering, University of the Witwatersrand. Teaching was in the following fields: ●Infrastructure provision (to undergraduate town planners and postgraduate development planners and urban designers): CIVN105: Civil Engineering in Relation to Planning; CIVNE01: Civil Engineering - a formal topic of TRPL523: Development Processes; ●Development engineering, infrastructure planning and management (to undergraduate civil engineers): CIVN101: Civil Engineering and Development; CIVN321: Urban and Development Engineering; ●Environmental and development economics and mathematical programming (to undergraduate environmental engineers): CIVN325: Operations Research; ●Water and sanitation, environmental health engineering (to postgraduates): CIVN510: Environmental Health Engineering.

Stephen Sproule

(1) Personal details: (1.1) Full names: Stephen Llewellyn Sproule (1.2) Date of Birth: 21 August 1967 (1.3) Nationality: South African (2) Educational qualifications: University of the Witwatersrand, Johannesburg, South Africa: (2.1) B.Sc. in Mathematics and Environmental Science. (1988) Professional Qualification: Higher Diploma in Education, (cum laude). (1989) (2.2) B.Sc. (honours) in Mathematics (teaching), (cum laude). (1990) (2.3) M.Sc. in Mathematics Education, (cum laude). (1994) Research report title: "The nature of the child's perception and visualisation of three dimensional diagrams in mathematics education." The Florida State University, Tallahassee, Florida, USA: (2.4) Ph.D. in Mathematics Education. (1998) Dissertation title: "An investigation of students' metaphors, metonymies and prototypes in algebraic reasoning and symbol manipulation" Directed by: N.C. Presmeg (supervisor); G. Wheatley; E. Jakubowski; M. Driscoll (3) Employment history: (3.1) June 2001-present: St John's College, Johannesburg: ●Mathematics Head of Department (incl. Cambridge A-Levels and Advanced mathematics). (Supervision of graduate research at the University of the Witwatersrand also currently undertaken). (3.2) 1998-Dec 2001: University of the Witwatersrand: ●Lecturer of mathematics and teacher education (School of Mathematics); ●Graduate teaching and supervision (School of Science Education); ●Research project co-ordinator (RADMASTE) (3.3) Aug 1994-1997: The Florida State University: ●Internship supervision; ●Middle and high school mathematics methodology; ●Mathematics courses for pre-service teachers; ●Graduate mathematics education courses to practising mathematics teachers (3.4) 1993-June 1994: Lyttelton Manor HS, Pretoria: ●Mathematics teacher (grades 8-12); ●Advanced Mathematics teacher (grades 11-12) (3.5) 1990&1992: University of the Witwatersrand: ●Tutor for first year mathematics (This included Calculus I, Calculus II and Linear Algebra); ●Tutor

for prospective mathematics teachers in the Higher Diploma in Education (3.6) 1991: SA National Defence Force: ● Instructor at an Adult Education Centre (3.7) 1990-1991: Sir Pierre van Ryneveld HS: ● Advanced mathematics teacher (grades 11-12) (3.8) 1984-1994: Self-employed: ● Private mathematics teaching for grades 7-12 (4) Selected additional relevant information: I developed and obtained university accreditation for an innovative year-long mathematics course, Foundations in Mathematics: Reasoning and Applications, which uses a problem solving approach to develop economically disadvantaged students' quantitative reasoning. This was the first course of its kind in South Africa. As a result of my work the course now serves students in Commerce, Architecture, Town Planning, the graduate certificate in Economics and is offered to assist mature students renegotiate mathematical reasoning on entering university through the Wits part-time programme. Under my leadership the class grew from around 50 to over 200 students.

B2 Follow-up detailed request for appointment and brief summary of early research

[LETTERHEAD]

Dear

Request for appointment in connection with a Water Research Commission Research Project on Knowledge Uptake

Further to our earlier discussion and documentation presented regarding the Water Research Commission research project "Knowledge Uptake by Technical Professionals and Decision-makers for Developmental Water Services", I would like to request the following specific participation by individuals in your [organisation]:

Specifics of the participation:

1. A total of approximately 6 hours of structured interviews/feedback sessions with individuals in [organisation], which would comprise nominally 3 individuals for a total interview plus feedback time ranging between approximately 1 and 3 hours each (split into more than one session as appropriate and practical); nominally $3 \times 2 = 6$ hours total.
2. The particular 'pool' of people from whom we would like to interview include: [individual names].
3. With respect to Knowledge Uptake of Developmental Water Services, we are seeking to understand better (a) the *context or environment* in which individuals are operating; and (b) *certain characteristics of the individual*. It is possible that some interviews might focus more on the context or environment, while others may focus more on the individual, and still others on a combination of the two. Tentatively, we have in mind nominally one (or possibly two) individuals for the slightly longer interviews covering a combination of the 'context', and 'individual' matters, and one or two others to focus more on the 'context' and (briefer) 'individual' matters.
4. We would prefer to work with individuals who would be *interested to work with us*, rather than them being 'press-ganged' into it !
5. Research benefits tend to be of a longer term rather than immediate nature, and accrue to the wider sector rather than to an individual local authority alone. In this particular case, we do feel that there is benefit in participation for individual participants as well as their organisations. However, we have made specific provision for the following matters in an attempt to ensure benefit to any participating organisations and individuals:
 - a. Where we interview individuals and take up work time, we can *pay from the research at a rate of R300 per hour* (the current maximum Water Research Commission hourly rate for researchers). For a total of 6 hours, that would come

to R1 800. [Organisation] could therefore bill the project for R1 800. Individuals can be paid directly. From the *project* side, there is nothing restricting that. We would simply have to be billed as such. However, we would prefer to pay the *organisation* for time used, OR alternatively to use that money to purchase particular books related to the research to give to the individual;

- b. We can *make available literature on developmental water services and on knowledge uptake*, which we have collected in the early part of the research, and have made provision for copyright payments to be made for materials compiled from other sources; and we can attempt to tailor it to some extent to the particular needs of the individual;
 - c. Particularly the structured interviews related to the *individual* would give the individual some insight into their own profile, which would be of particular individual benefit.
 - d. We would be happy to discuss with you any other ideas that you may have regarding what might be of mutual benefit, within the scope of what our resources will allow.
- 6. Although we think the first indications of some sort of pattern or patterns *may* emerge (we wouldn't pursue the research unless we felt that it was promising), the research is *exploratory*. We are trying to learn more, and to develop appropriate methodologies as much as get 'results'.
 - 7. The research is *focused on technical professionals and decision-makers (i.e. including politicians)* in *local government* - although we may well include one or two individuals from other spheres of government as well. We intend to interview personnel from more than one local authority, and a mix of big and small sizes. This is not a comparative exercise. Rather, we are trying to get a very tentative indication of ranges for technical professionals and decision-makers and a range of local authorities. We may well interview one or two politicians/technical professionals from other spheres of government as well, so that the research is not even of local government alone. It is of developmental water services.
 - 8. The *output of the research* will be in the form of a Water Research Commission research report (freely available in South Africa), as well as short (nominally 10 page) article in a widely-read magazine or journal, summarising the key findings and recommendations of the project, and targeted at key decision-makers.
 - 9. In the publication of any results, we will *take every precaution to protect the identities of individuals involved*; and any concerns in this regard can be raised and discussed at an early stage.

I look forward to hearing from you. And obviously, please do come back to me if you need further clarity or explanation on any matter.

[Researchers]

WORK IN PROGRESS

BRIEF SUMMARY OF RESEARCH - Mon 14 Mar 05

WRC Project K5/1519 'Knowledge Uptake by Technical Professionals and Decision-makers for Developmental Water Services Provision'

by Mark van Ryneveld and Stephen Sproule

1. PROJECT OUTLINE

10. **Topic:**
 - a. Knowledge uptake (KU) = *active acquisition* of disseminated information, *comprehension* + ability to *apply in the field*;
 - b. by *practitioners at the higher levels* = technical professionals + decision-makers;
 - c. of *Developmental Water Services* provision.
11. **Aims:**
 - a. *literature review* of (i) developmental water services provision; (ii) knowledge uptake; both individually and in combination
 - b. *develop methodology* to identify how KU is taking place
 - c. *initial assessment* of KU + *strategies to improve it*
12. **Methodology:**
 - a. 2 literature reviews (1+3=4 weeks)
 - b. brief sector survey on number of personnel and skills levels; abbreviated survey of KU by postal questionnaire (30 individuals; 10-20 questions); in-depth case studies of 4-6 individuals by interviews and interactions (4½ weeks)
 - c. final report + paper (2½ weeks)
(Total of 11 weeks or just under 3 months work)
13. **Simple statement of the problem:** From available literature, we know quite a lot about developmental water services provision. There would appear to be a supportive environment for these developmental approaches. Why then are these approaches not *better* applied in practice - as evidenced by the service delivery backlog and sustainability considerations?
14. **Focus:** *from the perspective of the individual technical professional/decision-maker* - rather than the organisation, or the disseminators of research, or policy-makers who constitute the broader context within which the individuals operate.

2. REVIEW OF DEVELOPMENTAL WATER SERVICES

1. **Curricula of tertiary level educational institutions** (*Local:* NCWSTI: BSc (Community Water Supply and Sanitation); Univ of KZN: MBA Water Management; Wits MM(P&DM); *Overseas:* Leeds Univ, School of Civil Engineering: MSc(Eng) Environ Eng and Proj Man; UNESCO-IHE Delft: International Masters Programme in Water Management)
2. **Information and Training Materials**
3. **Booklists and bibliographies**
4. **Organisations and websites**
5. **SA Government policies and related documents:**
6. **Conclusions:**

Fairly substantial and accessible material is available; however difficulties that may be contributing to poor uptake include:

- a. Internet may not be as user-friendly (download times, and time simply surfing);
- b. Format of the information may make KU difficult e.g. too little in summary form;
- c. Topics straddle traditional disciplines;
- d. Obstacles from the workplace;

Further contributing factors may include:

- e. The body of knowledge is not static; the most difficult to deal with is where whole new disciplines pop up, which are not sub-disciplines of existing ones, but are quite different and require quite different generic competencies;
- f. Terminology is a more complex matter than that of definition - it represents an approach to the work.

3. REVIEW OF KNOWLEDGE UPTAKE

1. *How does Knowledge Uptake differ from Knowledge Management:* Dent and Montague CIRIA report (2004): 'ability to obtain, incorporate and employ knowledge...rather than ownership'
2. *Emphasis:* (1) practitioners NOT current academic disciplines NOR communities; (2) individual practitioner NOT the KM + dissem in the organisation; (3) application+use; (4) understanding competencies NOT developing them on the job i.e. run training courses.
3. *Review in two parts:* (1) range of characteristics associated with components (disciplines); (2) Generic threshold competencies
4. *Brief re-visit of Developmental Water Services:* Nosich on 'a discipline': (1) vocabulary; (2) fundamental and powerful concepts; (3) central questions.
5. Also...(1) Suggest that DWS is an agglomeration of disciplines; (2) political+technical - different roles: trade-offs vs implementation; (3) interface=crucial

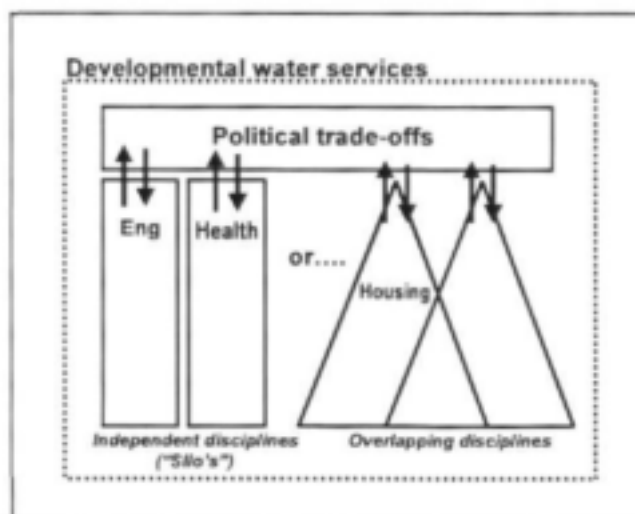


Figure 3.1: A suggested perspective on Developmental Water Services

6. *Characteristics:* (1) Herrman Brain Dominance Inventory (HBDI) - similar to Felder's Learning Styles (also Myers-Briggs); (2) Coaching across organisational cultures + characteristics of performance.
7. *Threshold competencies* - see Table of Competencies

NOTE - DRAFT ONLY

Table 3.1 Competencies for technical professionals and decision-makers

Methodical competency		Social competencies and competency of personage		
Academic	Practical	Administrative	Intrapersonal	Interpersonal
Active life-long learning - Accessing information - Lifelong professional development - Initiative	Numeracy - interpret engineering information - read and interpret graphs - perform basic calculations - interpret diagrammatic information - visualise plans & product	Business sense - estimate economic costs - understand business processes - knowledge of legislation and public policy	Active listening - synthesises different perspectives - observes interactions	People management and leadership Initiative and risk Respect of colleagues
Application of knowledge - Relevance of information - Interpret & analyse data - "assemble and integrate diverse strand of knowledge" - Evaluates viability - Comparing situation	Technical knowledge and skills - Experimentation - Scientific method - Instrumentation - knowledge of contemporary issues - materials and design knowledge	Judgement - Evaluating information - Isolate central issues - Decision-making - Checking viability of decisions	Creativity / Innovation - think laterally - original & alternative solutions - models solutions	Teamwork - Respect for others - Productive working relationships - Adds value to a team - Function on multi-disciplinary teams
Problem solving and posing - Apply knowledge - Analyse new situations - Overcome obstacles - Revise processes - Pose problems	Information (ICT) Skills - software applications - macro writing - design tools - Seek, store & retrieve info as needed	Ethical - shows integrity - belongs to prof societies - responsibility to the prof - confidentiality	Adaptable - anticipates and predicts change - manage change - helps others adapt	Working with stakeholders - Client focus - Understand needs - negotiation - works within socio-economic context
		Time management - establishing time frames - maintaining timelines - meeting deadlines	Awareness of self in context - Motivation - Designated responsibility - Multiple demands - Monitoring progress & correcting actions - problem sensitivity	Communication - English proficiency - AV presentations - Comprehension and writing - Oral communication - Interpersonal communication
		Environmental		

APPENDIX C - ABBREVIATED POSTAL/TELEPHONIC SURVEY QUESTIONNAIRE

- C1 Full questionnaire (short)**
- C2 Competency questionnaire (long)**

C1 Full questionnaire (short)

QUESTIONNAIRE FOR WRC RESEARCH PROJECT ON "Knowledge Uptake by Technical Professionals and Decision-makers for Developmental Water Services Provision"

General statements about developmental water services:

	Statements	strongly disagree	disagree more than agree	agree more than disagree	strongly agree	Comment
A1	Councillors as decision-makers.... play a specific role of <i>allocating resources and making trade-offs</i> between the different technical disciplines/departments in the provision of water services					
A2	Technical professionals in the water sector.... play a specific role of <i>implementing</i> water services, as set out in policy decisions by councillors					
A3	<i>Decisions</i> around the provision of water services in South Africa are <i>highly politicised</i> .					
A4	<i>Providing more technical information</i> about water services to councillors and/or technical professionals will assist significantly accelerate the provision of water services to poor communities					
A5	The <i>bureaucracy</i> in local authorities is a significant retarding factor in water services					

Learning styles: Sketches: Felder and Brent (1996: p.A7) Full questionnaire: see Solomon and Felder (2006) <<http://www.engr.ncsu.edu/learningstyles/ILSweb.html>>

Further detail: see Felder (2006): <<http://www.ncsu.edu/felder-public/ILSpage.html>>

Input modality		Processing		Understanding	
					
Visual	Verbal	Active	Reflective	Sequential	Global
Comment					

Competencies:

	Competencies	Technical professionals				Councillors				Comment
		seldom true	mostly not true	more true than not	often true	seldom true	mostly not true	more true than not	often true	
B1	Ongoing professional development ...stay abreast of developments in the field of water services									
B2	Application in practice, change and innovation (a)...can apply what they learn in real work situations									
	(b)...can adapt to new situations and manages change well									
	(c)...thinks creatively to produce original solutions and innovations									
B3	Numeracy, analysis and problem-solving (a)...understand quantitative technical information presented to them in simple tabular or graphical form									
	(b)...can analyse and evaluate given information and use it in the decision-making process									
B4	Judgement ...can apply sound judgement when evaluating information and making decisions									
B5	Communication (a)...listen well to people in discussion									
	(b)...communicate well orally									
	(c)...communicate well in writing									
B6	Ethics (a)...act with integrity in financial dealings									
	(b)...act with integrity in implementing services/decision-making									

C2 Competency questionnaire (long)

From the literature, we have compiled a provisional 'Competency grid' containing the range of competencies required by the water services sector as a whole. The statements below are each associated with a different part of the grid. For both Technical professional and Councillor, indicate whether you think the competencies are *required* and whether you think they have *got* those competencies i.e. the statements are *true*.

		Competency	Technical professional						Councillor					
			required?		got i.e. statement true?				required?		got i.e. statement true?			
			required	not required	seldom true	mostly not true	more true than not	often true	required	not required	seldom true	mostly not true	more true than not	often true
	1	Engages in active professional development in the field												
	2	Applies and integrates knowledge in real world situations												
	3	Can problem solve through evaluating and analysing situations												
	3a	Can evaluate and analyse a situation <u>with nothing given</u> , identify and obtain appropriate methods and data to solve the problem, and then apply												
	3b	Can analyse and evaluate <u>given</u> information and use it in the decision-making process												
	4	Can interpret engineering and graphical information, and perform basic calculations to check information provided												
	4a	Can understand quantitative technical information <u>presented/given</u> to him/her in simple tabular or graphical form												
	5	Able to <u>work with</u> necessary instruments and conduct or follow the creation of experiments												
	6	Can use the software required at work												
	7	Shows a business sense by estimating costs and understanding the basics of business processes												
	8	Knows and understands the basics of the legislation and public policy in the field												
	9	Applies sound judgment in evaluating information and making decisions												
	10	Shows integrity and professional responsibility												
	10a	Acts with integrity in financial dealings												
	10b	Acts with integrity in implementing services/decision-making												
	11	Is able to estimate the time to complete a project and works to reasonable deadlines												
	12	Is aware of environmental issues <u>when working</u> in the field												
	13	Listens to other perspectives with attention												
	14	Thinks creatively to produce original solutions and innovations												
	15	Can adapt to new situations and manages change well												
	16	Is motivated and responsible in work contexts												
	17	Manages multiple demands and is aware of progress in projects												
	18	Demonstrates leadership and manages people well												
	19	Works effectively in a team												
	20	Is attentive to other stakeholders (such as clients) within a socio-economic context												
	21	Communicates well with other people in discussion												
	22	Communicates well in writing												

Other related WRC reports available:

The use of key performance indicators in the benchmarking of rural water supply schemes: An aid to development of meaningful local government capacity.

Still D; Balfour F

Since 1994, DWAF has spent large sums of money on training water committees to manage the new water supply schemes. As projects have moved into the operational phase, it has become apparent that training alone is not adequate to ensure proper management of water supply schemes. The new local authorities have limited knowledge on the nature of inspection needed to promote good management at community level. Therefore, the challenge is to develop simple and effective systems that are easily understood by water committees. These can be used to report to the community as well as to their local authority. This project will test a set of key performance indicators (KPIs) that have already been developed. These will be tested on a number of RDP projects that are presently being transferred from Umgeni Water to relevant district councils in KwaZulu-Natal

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