

Knowledge uptake by technical professionals and decision-makers for developmental water services

Part 2: Individual competencies

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Abstract

While significant knowledge appears to be available on developmental water services (a term for service provision, to meet developmental objectives, with an emphasis on poor communities, in which a range of factors other than purely technical factors are addressed), there appears to be insufficient uptake of this knowledge (meaning the acquisition, comprehension and application in context) by technical professionals and decision-makers responsible for service provision, as evidenced by persistent service delivery backlogs and poor sustainability. This investigation developed and documented an exploratory methodology based primarily on in-depth interviews and a literature review which enabled the collection of evidence and development of a 'first pass' typology of knowledge, context and individual competencies with respect to developmental water services. This paper addresses individual competencies. The aspects of knowledge and context, as well as the overall methodology, are addressed in the companion paper (Part 1).

International literature reports a comprehensive list of competencies required by individuals working in the provision of water services. The interviewees participating in the research corroborated the list of the competencies found in the literature. The key individual competencies were classified as methodical competencies and social competencies or competencies of personage and presented in tabular form. In the South African context numeracy, knowledgeable analysis, adaptation to change and various communication competencies as well as an ability to make sound judgments were considered particularly important and given more significance by the interviewees than ascribed in the international literature.

More generally, the investigation established that for effective provision of water services within a developmental context, there is a close relationship between the 3 components of knowledge, context and individual competencies; and that it is difficult to address any one of the 3 components without reference to the other two.

Keywords: knowledge, developmental, water services, decision-makers, technical professionals, context, individual competencies, bureaucracy, interviews

Introduction

While the companion paper (Part 1) addressed the methodology, the knowledge available on developmental water services and the context within which it is applied, this paper addresses individual 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.

The research was conducted using in-depth open ended interviews. This methodology is particularly useful in that it gets at the interviewee's deeper understanding and perceptions of the issues. Although this method is time consuming and results in large quantities of data that must be summarised, interrogated and analysed, the depth of insight into competencies required of and competencies evident in individuals in the provision of water services is significant.

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 consider-

ing 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 2 perspectives:

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

In this investigation – 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

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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 technician slant. It is, however, interesting to note that even when civil engineers are the primary practitioners in 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 paper 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.

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 2 levels (Peiro, 2001) (**Bold numbering in brackets** – e.g. **(1)** – refers to numbering in Table 1: Competencies for Technical Professionals and Decision-Makers):

- The first level distinguishes between methodical competence (MC) **(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)**.
- 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 2 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 3 sub-clusters, namely, administrative **(2.1)**, interpersonal **(2.2)** and intrapersonal **(2.3)** competence.

The breakdown and clustering of competencies has been selected so as to provide a generic set of 'building blocks' that can be widely applied. More general tasks such as 'project management' or 'strategic planning' do not appear in the table, but would be made up of combinations of these more fundamental competencies.

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.

A summary of the competencies has been produced for quick reference and may be found in Table 1. Table 1 has been formulated from the competency issues raised in the literature and revised using the comments of the interviewees.

Tables 2 and 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.

In the more detailed discussions of the competencies which follow, 2 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. (Note again that **bold numbering in brackets** – e.g. **(1)** – refers to numbering in Table 1: Competencies for Technical Professionals and Decision-Makers).

Methodical competence (1)

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

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		

numeracy (1.2.2), and information (ICT) skills (1.2.3).

In this investigation we have chosen to focus on 3 primary categories of knowledge and the accompanying competencies that are significant in the water sector. All 3 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 abil-

TABLE 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:

- 1 Interviewees: SM = Senior Manager SC = Social Consultant
 TM = Technical Manager TC = Technical Consultant
 C = Councillor

- 2 Coding for classification: -1 = Required, but not very good at it
 1 = Some good some bad
 0 = Not a required skill
 2 = Required and people are generally good at it
 + = '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)
 # = '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
Areas of concern and grave concern in the competencies of technical professionals and decision-makers, 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 2 (e.g. 1 'Engage in active professional development in the field') are followed by the equivalent competency categories from Table 1 in square brackets (e.g. [= Active life-long learning (1.1.1)])

ity to integrate diverse fields of knowledge in real and often complex contexts.

It is clear that the 3 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 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:

- Compare information looking for contradictions or reinforcement of ideas
- Determine the relevance of given information to a situation
- 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
- Evaluate the viability of given solutions and identify potential pitfalls; and consequently
- 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

In addition to the comments made by the interviewees, Tables 2 and 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)
- To generalise 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 3 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: 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
True divergent problem solving, requiring major strategic trade-offs to be made, and usually carried out by politicians.

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 by-products of schooling and tertiary education.

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

‘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 4 participants demonstrating numeracy are presented below.

'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
'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 6 000 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 6 000 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 to 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.

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. Besides 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 busi-

ness 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 3 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

'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.

(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

In addition to the remarks made in the interview, the results from the score sheet (Table 2 and 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 frame-

works 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 2 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 2 and 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. In most cases listening appeared to be passive, with 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. 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 3 key competencies in the provision of water services. 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 3 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 2 and 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

Interpersonal (2.3)

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 pre-planned 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 (or significant) than working with team members within the department. 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. 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 (Table 2). 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 3 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, shar-

ing 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 2 and 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 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.

Conclusions

A framework of competencies:

- 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. 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).

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) 3 levels of methodical competence (Table 1: Section 1), namely:

- **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)
- **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)
- **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.

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