

**THE ROLE OF WASTE DATA IN CHANGING
BEHAVIOUR: THE CASE OF THE SOUTH AFRICAN
WASTE INFORMATION SYSTEM (SAWIS)**

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DECLARATION

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ABSTRACT

The South African waste information system (SAWIS) developed and implemented by the Department of Environmental Affairs in 2006, provided a unique case study to explore the research question “*Can the collection of data for a national waste information system change the way waste is managed in South Africa, such that there is a noticeable improvement?*” The research adopted an inductive approach, incrementally constructing a conceptual model of the knowledgeable, situated waste actor, through observation and hypothesis-building and -testing. The thesis draws on theory from the fields of environmental information disclosure, science communication, environmental education, and environmental psychology, in an effort to understand and contextualise the influence of waste data and knowledge on waste behaviour.

Two empirical studies were undertaken in 2006 and 2011. The studies explored whether SAWIS could create opportunities beyond simply being a tool for data collection, by building the waste knowledge of those persons tasked with the responsibility of collecting and reporting the data. The thesis posited that this new knowledge could lead to changes in personal behaviour and ultimately changes in the way organisations manage their waste. While Miller & Morris’ (1999) theoretical framework of learning provided a useful means of interpreting the 2006 data, the results showed the theoretical framework to be overly simplistic for understanding the role of waste data in a developing country context such as South Africa, in that it did not account for all of the evidence gathered, particularly the existence of behavioural and situational influences.

The preliminary theoretical framework was expanded in the 2011 empirical study by including Ajzen’s (1985) theory of planned behaviour. Situated within a pragmatic paradigm, the research adopted a mixed-methods research approach, making use of both quantitative and qualitative methods. The results showed that of the three constructs of knowledge (experience, data, and theory), experience currently has the greatest influence on building waste knowledge, nearly twice that of data/information and three times that of theory. Together the three variables (experience, data, and theory) account for 54.1% of the variance in waste knowledge. Knowledge is shown to have a significant influence on all three of the antecedents to behavioural intention – attitude, subjective norm and perceived behavioural control. Furthermore, perceived behavioural control, and not intention, has the greatest influence on waste behaviour, with the model accounting for 53.7% of the variance in behaviour. Respondents from public and private waste organisations represent two distinct sub-groups in the data set, subject to significantly different influences and behaviours, creating two local

models. The theoretical framework accounts for 47.8% of the variance in behaviour in the municipal local model, and 57.6% of the variance in behaviour in the private local model. By applying the combined learning-behaviour theories, the results showed that there are only three regressors that currently have a significant effect on waste behaviour, *viz* experience, knowledge and perceived behavioural control.

Two important conclusions were reached by combining the learning-behaviour theories. First, that there are obstacles that hinder the translation of intention into behaviour in the South African context, which suggests that good waste management practice is not always under the volitional control of those tasked with its implementation. Second, that there are significant differences in the way waste knowledge and behaviour are constructed, which suggest that there are underlying social forces that shape waste behaviour and that these forces may be different in public and private waste organisations. Recognising the influence of both societal structures and agency, the theoretical framework was further expanded by embedding the two linear learning-behaviour theories within Giddens' (1984) theory of structuration.

The conceptual model of the knowledgeable, situated actor developed through this research, provides a means of understanding these barriers to action and the societal context within which waste management takes place in South Africa. From the results it is clear that a tension exists between the national neo-liberal, capitalist economic structures which support a pro-growth paradigm, and the political structures which support a pro-poor social paradigm. Furthermore, this tension plays out within a country undergoing political and organisational transformation post-1994. These structures directly influence the way waste is managed. This research proposes that by understanding the way in which knowledge and behaviour are constructed, and the societal context within which this takes place, it is possible to identify practical interventions that will lead to an improvement in the way waste is managed in South Africa.

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LIST OF ABBREVIATIONS

A	Attitude
ANC	African National Congress
CBO	Community Based Organisation
CI	Confidence Interval
CSIR	Council for Scientific and Industrial Research
DANIDA	Danish International Development Agency
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DPLG	Department of Provincial and Local Government
DWAF	Department of Water Affairs and Forestry
EMP	Environmental Management Plans
EIP	Environmental Implementation Plans
EPER	European Pollutant Emission Register
GEAR	Growth, Employment and Redistribution policy
GLB	General waste large landfill
GMB	General waste medium landfill
IDP	Integrated Development Plan
IP & WM	Integrated Pollution and Waste Management
ISO	International Organization for Standardization
IT	Information Technology
IWM	Integrated Waste Management
IWMP	Integrated Waste Management Plan
NEM	National Environmental Management
NEMA	National Environmental Management Act
NGO	Non-governmental Organisation
NGP	New Growth Path
NPI	National Pollutant Inventory
NPRI	National Pollutant Release Inventory
NWMS	National Waste Management Strategy
NWMSI	National Waste Management Strategy Implementation
PBC	Perceived Behavioural Control
PLS	Partial Least Squares
PLSPM	Partial Least Squares Path Modelling
PRTR	Pollution Release and Transfer Register

RDP	Reconstruction and Development Programme
REL	Rear End Loader
RSA	Republic of South Africa.
SAWIS	South African Waste Information System
SD	Standard Deviation
SDIP	Service Delivery Improvement Plan
SE	Standard Error
SEM	Structural Equation Modelling
SN	Subjective Norm
ToPB	Theory of Planned Behaviour
TRI	Toxic release inventory
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNITAR	United Nations Institute for Training and Research
US	United States of America
WIS	Waste Information System

CHAPTER 1: THE PROBLEM AND ITS SETTING

1.1. Introduction

Solving today's environmental problems is still often thought of as solely an engineering or technical challenge, "*to be handled by engineers, physicists, and other practitioners of hard science*" (McAndrew, 1993). However, environmental problems are at their root social or behavioural problems (Maloney & Ward, 1973; World Bank 2002). As a 'life-world problem' that cuts across disciplinary frameworks (Kueffer *et al.*, 2007; Pohl, 2008), correcting environmental problems and providing sustainable solutions, requires a trans-disciplinary approach which combines "*scientific, technical and social knowledge*" (Sharp *et al.*, 2011:503). With the complexity associated with solving environmental problems, and in this particular case, waste management problems in South Africa, the need exists for trans-disciplinary research. To provide a more integrated approach to addressing the research question, this research is therefore placed at the interface between engineering, waste management, information management and social sciences.

The aim of the research is to explore the potential for waste data to change the way waste is managed in South Africa. As such, the study focuses on waste data within the South African waste information system (SAWIS) and how this data is currently being used in public and private waste organisations to generate knowledge, and ultimately change waste behaviour. This chapter provides an introduction to and context for the research; an overview of the status of waste management in South Africa; the need for waste information; the role of information as policy instrument; and the development and implementation of SAWIS in South Africa.

1.1.1. The status of waste in South Africa

As a developing country, South Africa is faced with many basic social livelihood challenges, such as access to food, shelter, water and sanitation, employment, education, and security (World Bank, 2004; NPC, 2011). With competing priorities, and demands on available resources, waste has typically not been afforded the priority it deserves (RSA, 2000; Coetzee, 2006; Hoon *et al.*, 2006). As a result, "*insufficient funds and human resources were allocated to this [waste] function. In many instances this neglect has resulted in a lack of long-term planning, information, appropriate legislation and capacity to manage the waste stream*" (RSA, 2000:23).

This low priority given to waste has resulted in environmentally and socially unacceptable practices, and a general decline in the quality of waste management in South Africa, particularly within municipalities (Ball, 2006; DEAT, 2006a; Hoon *et al.*, 2006). In particular, unacceptable waste practices have resulted in substandard, ineffective or non-existent waste collection and street-cleaning systems; illegal dumping and littering; waste disposal sites which are poorly operated and impact negatively on the environment and human health; and the presence of pickers at landfill sites, who disrupt operations and are exposed to hazards which affect their health (RSA, 2000; Ball, 2006). Furthermore, these issues of poor waste management remain a challenge, a decade after the publication of South Africa's waste management policy, the White Paper on Integrated Pollution and Waste Management (IP&WM) (RSA, 2000), and 17 years after the democratisation of South Africa in 1994 (Moeletsi & Novella, 2004; Grobbelaar & Dube, 2006).

Municipalities blame poor waste management performance on financial and institutional constraints, such as lack of budget, capacity (and in particular skilled capacity) and equipment (Zurbrugg, 2002; Godfrey, 2006; Grobbelaar & Dube, 2006). According to Coetzee (2006:1) the gap in service delivery by municipalities is,

“further exacerbated by dynamic complexities created by the scarcity and competition for funds and resources, to be able to create and maintain sufficient waste management systems and infrastructure for service delivery, whilst complying with social and political reforms, and meeting the expectations of job creation, economic growth and urban development.”

South Africa is estimated (as at 1997) to generate 533.6 million tons/annum of waste, of which 488.8 million tons/annum (91.6%) is mining and power generation waste; 20.0 tons/annum (3.8%) is agricultural and forestry waste; 16.3 tons/annum (3.1%) is industrial waste and 8.5 (1.6%) is domestic and trade waste and sewage sludge (DWAF, 2001a). As at 1997, there were 540 known operating landfills (DWAF, 2001b) in South Africa, with an estimated 15 000 communal (GCB) waste disposal sites (< 25 tons/day) (DWAF, 1998). The Baseline Studies (DWAF, 2001a) showed that only 26% of these landfills had permits, and of those landfills permitted, 12% were unacceptable, while others did not comply with the Minimum Requirements¹ (DWAF, 2001b). A follow-up census of disposal sites, conducted by the Department of Environmental Affairs and Tourism (DEAT) in 2005 (DEAT, 2006) showed that there were 1203 known landfills in South Africa, of which 524 (43.6%) were permitted. While

¹ The Minimum Requirements are a set of documents on the minimum requirements for waste disposal by landfill, and minimum requirements for handling, classification and disposal of hazardous waste, published by the Department of Water Affairs and Forestry in 1998, and given legal effect through the Environmental Conservation Act, Section 20 permits.

there was an improvement in the percentage of permitted landfills in South Africa between 1997 and 2005, there is little to no information on the standard of operation of these landfills and the levels of compliance of the landfills with their permit conditions. An analysis of the findings of the landfill census, suggests that of the non-permitted/unknown permit status landfill sites, in excess of 90% are thought to be municipal landfills. The biggest culprit of non-compliance in the landfilling of waste would appear to be government itself (Godfrey, 2008). No national data on the generation and disposal of waste has been collected since the 1997 Baseline Study (DWAF, 2001a), however the Department of Environment (DEA) have commissioned a new national waste baseline in 2011 for completion in 2012.

Economic development, population growth, urbanisation, and the inefficient use of resources have resulted in an increase in the generation of waste in South Africa (DEAT, 2002; Fiehn & Ball, 2005). According to Fiehn & Ball (2005) while waste volumes have increased, the response in the management of waste has not corresponded with this increase, resulting in a shortfall in appropriate service delivery, legal compliance of waste facilities and available budget, capacity and enforcement. Unless properly managed waste has the potential to impact directly on human health and the environment (DWAF, 1997; Zurbrugg, 2002; Kolominskas & Sullivan, 2004; Poch *et al.*, 2004), whether it be ground or surface water, soil or air. To guarantee the basic human right of the South Africa public to an environment that is not harmful to their health or well-being (RSA, 1996) it is imperative that waste be responsibly managed.

1.1.2. The need for waste information

As a result of the waste management challenges facing South Africa, national government identified seven strategic goals for achieving IP&WM (RSA, 2000). Waste information management is included as one of these seven goals (Goal 6). Waste data and information were recognised early on in South Africa's waste policy and legislative reform process, as a means to achieve IP&WM.

"Monitoring and collection of information on pollution and waste generation are crucial for the implementation of pollution and waste reduction measures. Moreover, the sharing of such information and creating awareness about the issues will enable all stakeholders, including communities, to gain a better understanding of the relation between pollution, waste management and the quality of life" (RSA, 2000:5).

In support of Goal 6, the DEAT identified in its National Waste Management Strategy (NWMS) (DEAT, 1999) and White Paper on IP&WM (RSA, 2000), the need for a national waste

information system (WIS) to provide “*accessible information to interested and affected parties that will support effective integrated pollution and waste management*” (RSA, 2000:42). While the long-term objective of the White Paper on IP&WM was the establishment of a Pollutant Release and Transfer Register (PRTR), which includes information on point and non-point releases and transfers to air, water and soil, the short-term deliverables were recognised as being the development and implementation a WIS.

1.1.3. The purpose of waste information

The role of waste information in effectively managing waste is not unique to South Africa, but has been recognised internationally for some time (van Rooyen, 1990; Huang *et al.*, 2002; Sheshinski, 2002; Coetzee *et al.*, 2004). Waste information has been used for a variety of purposes, including decision-making, planning, research and development, community right-to-know, policy development, compliance monitoring, and environmental reporting obligations.

Informed *decision-making* is at the crux of many of the following identified uses of waste information. *Monitoring* of waste activities forms the basis from which issues or priorities for action can be identified and appropriate action taken (Baltais, 1994; Glenn, 1994; Nauman, 2004; Vlahos *et al.*, 2004). The way in which this waste information is utilised to address these actions forms the basis of informed decision-making (Mayne, 1990; Law, 1996; Bharati & Chaudhury, 2004; Vlahos *et al.*, 2004). Waste information to support decision-making is not only applicable to government, but applies to industry and communities (Trio, 2001; Nauman, 2004). Waste information also forms the basis of future *planning*, by providing a status quo assessment or overview of current waste management activities (Mayne, 1990; Sheshinski, 2002; Abou Najm & El-Fadel, 2004; Gaschick-Wolff *et al.*, 2004; Vlahos *et al.*, 2004). Monitoring of waste management activities enables government and industry the opportunity to track *compliance* against existing legislation and take action where compliance has been contravened (Kourous, 2000; Gaschick-Wolff *et al.*, 2004; Nauman, 2004). Information is required to support *international, environmental reporting obligations* (Howes, 2001), for example under Agenda 21 (UN, 1992). Waste information, whether collected by government or industry is a vital component of waste *research and development* (Howes, 2001; Gaschick-Wolff *et al.*, 2004).

Government departments and non-governmental organisations (NGOs) have made information on pollution and waste releases available to the public, through *community right-to-know initiatives* (Trio, 2001; Le Roux, 2004; Nauman, 2004; Schmidt, 2004). The rationale for making such information available to the public includes, raising the awareness of communities

with regards to the associated risks of nearby releases (Howes, 2001); capacitating communities to participate in environmental decision-making and policy development (Kolominskas & Sullivan, 2004; Nauman, 2004); and perhaps the most well documented and most self-serving on the part of government, is to enable communities to place pressure on industry to reduce emissions and discharges (Law, 1996; Antweiler & Harrison, 2003; Kolominskas & Sullivan, 2004).

Waste information has also been useful in *achieving policy objectives* (Baltais, 1994; Ballantyne, 1995; Sheshinski, 2002). The best known example of using waste information to achieve desired policy outcomes is through community right-to-know waste information programmes such as the toxic release inventory (TRI) implemented in the United States (Howes, 2001; Weiss, 2002; Antweiler & Harrison, 2003; Kolominskas & Sullivan, 2004; Nauman, 2004). Policy goals can be achieved through direct interventions, such as passing legislation that forces industry to reduce releases, or through indirect interventions, e.g. through community right-to-know, where communities place pressure on industry to reduce emissions, thereby achieving the original policy goal.

Providing waste information to government and communities has, in certain countries, resulted in a noticeable decrease in the generation of waste and the release of pollutants into the environment (Antweiler & Harrison, 2003; Kolominskas & Sullivan, 2004; CEC, 2004). The decrease in pollution and waste may be attributed to: public pressure (Baltais, 1994); traditional regulation (Antweiler & Harrison, 2003); or to an increase in the awareness of those people working in industry (Glenn, 1994; Weiss, 2002). According to some, the ultimate outcome of providing reliable waste information to decision-makers is the improved *management of the waste* (Sheshinski, 2002; CEC, 2004; Kolominskas & Sullivan, 2004); the reversal of environmental degradation; and the improvement of community health (Nauman, 2004).

1.1.4. The role of waste information as policy instrument

The White Paper on IP&WM (RSA, 2000) identifies three types of regulatory instruments in the management of pollution and waste:

- a. *Command-and-control instruments* (directive-based regulation), which involve direct regulation and rely primarily on the application of regulatory instruments, such as standards, permits and land-use controls
- b. *Market-based instruments* (incentive-based strategies), whose objective is to change behaviour by promoting specific innovations that lead to improved environmental performance, and

- c. *Voluntary agreements* (incentive-based strategies), which are adopted by industry as a complementary approach to pollution reduction, but seldom as a replacement for direct government control

A fourth policy instrument, that of information disclosure (information-based strategies) (**Figure 1-1**), has emerged internationally over the past two decades as an instrument capable of 'eliciting' or 'inducing' desired policy outcomes (Weiss, 2002; Antweiler & Harrison, 2003; Kolominskas & Sullivan, 2004).

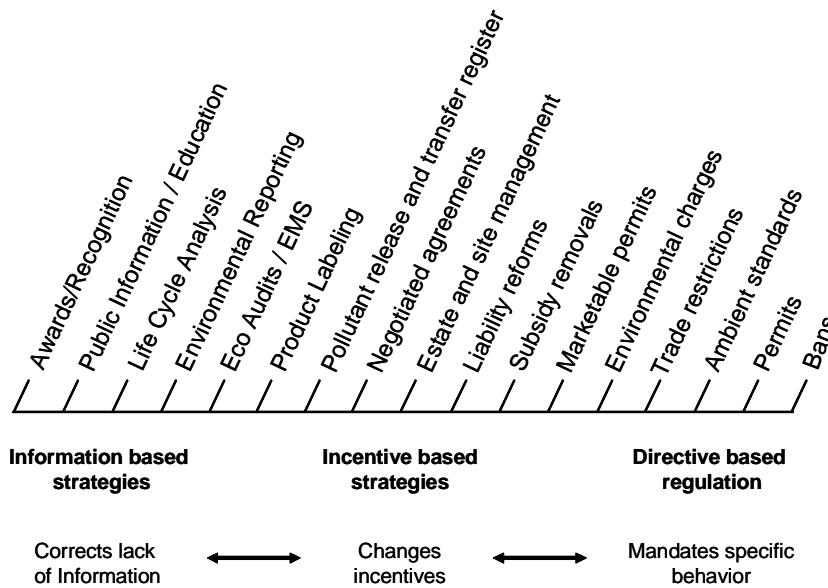


Figure 1-1. Range of instruments for environmental policy (from Bosman, 2005)

Information can make people aware of the *consequences* of their behaviour and influence their *awareness and knowledge* regarding this behaviour (Howes, 2001; Weiss, 2002). Policy makers then rely on people to use these newly acquired skills to change their behaviour so as to meet the required policy intention. Two ways in which information may support desired policy outcomes, is through a top-down approach or bottom-up approach (Weiss, 2002). In a top-down (or direct) approach, government makes information available to persons or organisations that need or want it. Examples of top-down interventions include, on the positive side, information campaigns, technical assistance, dissemination of research findings, statistical information, and on the negative side, propaganda, and indoctrination (Weiss, 2002). In a bottom-up (or indirect) approach, government creates the environment for other persons or organisations to generate and share information. Here government "*sets in motion a process of information collection or learning.*" (Weiss, 2002:218). Examples of bottom-up interventions include training, research, reporting and recordkeeping, auditing, evaluation, labelling, public disclosure, environmental impact statements, and public hearings (Weiss, 2002).

Information policies therefore rely on people to change their behaviour after coming into contact with the information. The underlying assumptions in an information policy approach is that people respond to information; respond to information out of their own accord; have limitless capacity to absorb new information; and have endless motivation to alter their behaviour based on what is considered 'optimal behaviour', and that knowledge is linked to action (Weiss, 2002). The policy approach also assumes that people are rational and that they make decisions by adjusting both automatically and continuously to information that highlights the consequences of their actions (Weiss, 2002).

While information policy has been used internationally in many domains ranging from public health, energy conservation, environmental management to family planning (Weiss, 2002), perhaps the most well known example of successful information strategies, is the toxic release inventory (TRI), a pollutant release and transfer registry (PRTR) implemented in the US in 1986 in response to the chemical accident at a Union Carbide plant in Bhopal, India (Terry & Yandle, 1997; Nauman, 2004). Based on the principles of community-right-to-know, the TRI requires that certain listed industry types report on the quantity and types of pollutants released to air, water and soil, and transferred off-site for disposal, which are then made available to government and the public. The result of the TRI has been that companies have reduced their generation of waste and/or associated discharges and resultant environmental impacts, through raised organisational awareness of wasteful processes and as a result of social pressure (Howes, 2001; Weiss, 2002; Antweiler & Harrison, 2003; Kolominskas & Sullivan, 2004;). Savings of up to \$360 million in raw materials with emission reductions of up to 192 million kilograms have been realised in facilities due to improvements in processes sparked by the TRI (Nauman, 2004). However, according to Weiss (2002), evidence suggests that TRI organisational reports are more effective internally to the 'polluting' organisation than to external actors. This is possibly due to the public's lack of awareness of, or interest in, waste and pollutant data (Howes, 2001; Nauman, 2004); lack of demand for pollutant data (Sissell, 1998); and difficulty in interpreting complex pollutant data (Gunningham, 1995).

Since the implementation of the TRI in 1986, many other countries have developed and implemented pollutant and waste information systems, some more successfully than others. Examples include the National Pollutant Release Inventory (NPRI) (Canada); the European Pollutant Emission Register (EPER); and the National Pollutant Inventory (NPI) (Australia) (Baltais, 1994; Howes, 2001; Antweiler & Harrison, 2003; CEC, 2004; Kolominskas & Sullivan, 2004; Schmidt, 2004; US EPA, 2003a,b). The drive to implement pollutant release systems has been driven largely by the United Nations Conference on Environment and Development (UNCED), the adoption of Agenda 21 (United Nations, 1992), further supported

by the Aarhus Convention (UNECE, 1998) on public access to information, and the Johannesburg Plan of Implementation (UN, 2002) emanating from the Johannesburg World Summit on Sustainable Development (2002). However, most countries currently operating such pollutant and waste information systems are developed countries. Countries such as South Africa, Swaziland, Mexico and Thailand, with developing economies, have struggled to successfully develop and implement such systems (Kourous, 2000; DEAT, 2004; Nauman, 2004).

1.1.5. The sustainability of data collection programmes

While the success of information strategies in attaining policy goals is recognised, many information strategies and their supporting information systems have not been sustainable² in the long-term, particularly in developing countries. Developed countries show up to a 50-85% partial or total failure rate of information systems (Heeks, 2002). Developing countries experience a comparatively higher failure rate than that of developed countries (Peterson, 1998; Heeks, 2002). This is due to a lack of appropriate technical and human infrastructure (Heeks, 2002; Moussa & Schware, 1992); limited management capacity and commitment (Peterson, 1998); high government staff turnover (Moussa & Schware, 1992); an unsupportive public sector culture (Peterson, 1998; Mursu *et al.*, 2000); post-development withdrawal of donor funds (Heeks, 2002); and adoption of often overly complex or unsuitable industrialised country information systems (Odedra, 1993; Peterson, 1998; Heeks, 2002). According to Peterson (1998:38), “*information systems fail or underperform more often than they succeed in the public sector in Africa*” primarily because “*they outstrip the capacity of government staff to manage. The management task is formidable.*”

The United Nations Institute for Training and Research (UNITAR) initiated pilot projects of the PRTR systems in Mexico, Egypt and the Czech Republic in 1994 (IFCS, 1997). However, after a decade of attempted implementation of the PRTR in Mexico, little success has been achieved (Nauman, 2004). Similar attempts to implement a PRTR pilot project in Thailand's Map Ta Phud Industrial Estate between 2000 and 2001, also failed. South Africa has similarly had little success in the implementation of waste information systems (DEAT, 2004). Of the 10 known waste information systems developed in South Africa since 1999, six systems are no longer operational having succumbed to either total or sustainability failure, with one system still to be implemented (DEAT, 2004).

² Sustainability is defined as the “*the ability of a programme or project to continue, and to continue being effective, over the medium to long-term*” (UNAIDS, 2005).

1.1.6. South African waste information system

The South African Department of Environmental Affairs and Tourism (DEAT)³ developed, piloted, and implemented the South African waste information system (SAWIS), between 2004 and 2006. The SAWIS was piloted in two provinces in South Africa, Mpumalanga and Eastern Cape. Given the failing of previous waste information systems in South Africa, and the capacity and financial constraints of data providers, the SAWIS adopted a conservative approach to system design and data requirements. According to DEAT (2005:1) it is the intention of the Department to collect the required information "*without placing undue financial and capacity burden onto industry and the private sector, who will be responsible for providing the data, and government, who will be responsible for collecting, verifying and disseminating the data and information.*"

The DEAT requires the owners or operators of medium and large (GMB, GLB) general waste landfills, hazardous waste landfills, waste treatment facilities, waste reprocessors⁴, and waste exporters, to report on monthly waste tonnage data to SAWIS. The submission of data to SAWIS has been on a voluntary basis since its implementation in 2006. While regulations have been drafted to enforce reporting to SAWIS, these regulations are yet to be promulgated.

1.2. Problem statement

From the above information, it is evident that the South African waste sector faces many challenges. In addition, the tonnages of waste generated in South Africa are expected to increase in the future, as the economy develops and as the population grows. Alternative waste treatment and reuse technologies have been successfully introduced into South Africa; however, waste disposal, and in particular waste to landfill, remains the dominant means of waste management in the country (Matete & Trois, 2008; Trois *et al.*, 2007). Most domestic waste is disposed of to municipal landfill sites, the majority of which are not permitted or not operated according to permit conditions. Municipalities, who are responsible for the management of domestic waste, face many operational challenges. In the context of the current neoliberal global economy, many private waste companies are being established in response to this growing opportunity. Many of these private companies operate according to international best practice; however, there are companies that see waste as an opportunity for quick profits.

³ The Department of Environmental Affairs and Tourism (DEAT) is now known as the Department of Environmental Affairs (DEA).

⁴ A waste reprocessor is typically a commercially run waste facility which converts waste into a reusable material, e.g. plastic, glass, paper, metal reprocessors

While many of the current waste problems can be ‘fixed’ through engineering or technical solutions, some waste practitioners suggest that what is required is a change in the behaviour of those tasked with the management of waste. Waste information has been shown to be successful in changing waste behaviour, particularly in developed countries. The SAWIS therefore provides a unique case study to explore the role of waste data in shaping waste behaviour, in this case in a developing country context.

1.3. The research question

Given the above background and problem statement, this research addresses the question: ‘*Can the collection of data for a national waste information system, change the way waste is managed in South Africa, such that there is a noticeable improvement?*’ By answering this question, the thesis aims to contribute to the theoretical debate on the role of information and knowledge in influencing changes in behaviour, in this case, behaviour that will bring about good waste management practices in a developing country in transition; as well as provide recommendations for the SAWIS to improve waste management in South Africa. The thesis therefore has a theoretical and applied purpose.

The research aims to explore the potential influence of SAWIS data on the waste behaviour of respondents participating in the SAWIS programme in South Africa during the period 2005-2011. The behaviour under investigation is ‘good waste management practice’, defined for the purposes of this research as: “*waste activities that are compliant with waste and environmental legislation; that promote the waste hierarchy and support waste avoidance, minimisation, reuse, and recycling; and that minimise the impact of waste and possible associated pollution on the environment and human health*”.

1.3.1. The sub-questions

To answer the overall research question, a number of sub-questions must be addressed. These sub-questions include:

1. What are the waste data needs in South Africa?
2. What is the current role of waste data in managing waste in South Africa?
3. What influence does SAWIS data have on building waste knowledge?
4. What influence does SAWIS data have on waste behaviour?
5. What are the barriers to good waste management practice?
6. What are the underlying societal structures that shape waste behaviour?

The researcher has elected to undertake the PhD research presented in this thesis by means of published papers. Each sub-question is addressed in a peer-reviewed journal paper, either published or submitted for publication, and which make up the following chapters of this thesis (**Table 1-1**). Research into sub-questions 1 and 2 was undertaken in 2005-2006 as part of the piloting of SAWIS. Research in support of sub-questions 3-6 was undertaken in 2010-2011, five years after implementation of SAWIS.

Table 1-1. Sub-questions as addressed per thesis chapter and publication

Sub-question	Chapter	Publication
1. What are the waste data needs in South Africa?	Chapter 2	Godfrey, L. (2008). Facilitating the improved management of waste in South Africa through a national waste information system. <i>Waste Management</i> 28(9): 1660–1671.
2. What is the current role of waste data in managing waste in South Africa?	Chapter 3	Godfrey, L. and Scott, D. (2011). Improving waste management through a process of learning: the South African waste information system. <i>Waste Management & Research</i> , 29(5): 501–511.
3. What influence does SAWIS data have on building waste knowledge?	Chapter 4	Godfrey <i>et al.</i> (forthcoming 2012a), accepted by <i>Waste Management</i>
4. What influence does SAWIS data have on waste behaviour?	Chapter 5	Godfrey <i>et al.</i> (forthcoming 2012b), accepted by <i>Waste Management</i>
5. What are the barriers to good waste management practice?	Chapter 6	Godfrey <i>et al.</i> (forthcoming 2012c), submitted to <i>Waste Management & Research</i>
6. What are the underlying societal structures that shape waste behaviour?	Chapter 7	Godfrey <i>et al.</i> (forthcoming 2012d) , submitted to <i>Journal Environmental Science and Policy</i>

1.4. Research methodology

A description of the chosen philosophical and methodological foundations applied during the course of this research is presented, where appropriate, in Chapters 2-7. This section situates this body of research within a ‘pragmatic paradigm’, and outlines the mixed-methods design applied in this research. This design combines both quantitative and qualitative research methods (Gelo *et al.*, 2008; Teddlie & Tashakkori, 2009).

The ontological and epistemological assumptions of the nature of reality and the construction of knowledge, guide the selection of appropriate research methods (Guba & Lincoln, 1994; Brannen, 2005). Positivism, as a philosophical paradigm that has dominated the physical and natural sciences, is based on the ontological assumption of the existence of an ultimate truth and

reality that can be known through observation and measurement, and the epistemological assumption that the investigator can objectively study an item without directly influencing it, or being influenced by it (Guba & Lincoln, 1994; Gelo *et al.*, 2008; Sharp *et al.*, 2011). With an emphasis on realism the hypotheses are subjected to experimental testing, which rely heavily on quantitative methods (Guba & Lincoln, 1994; Leedy & Ormrod, 2005). The paradigm of interpretivism, on the other hand, is based on the ontological and epistemological assumptions of a socially constructed, subjectively-based reality (Mottier, 2005; Gelo *et al.*, 2008). Research is focussed on uncovering meaning and understanding, and relies on the application of qualitative methods (Leedy & Ormrod, 2005).

An alternative philosophical paradigm has emerged over the past 20 years, which rejects the notion of using exclusively a positivist or an interpretive paradigm (Gelo *et al.*, 2008; Teddlie & Tashakkori, 2009). A pragmatic paradigm adopts a context-driven approach where the research method is chosen based on the research question and purpose (Brannen, 2005; Gelo *et al.*, 2008; Teddlie & Tashakkori, 2009). Research within the pragmatic paradigm therefore makes use of a mixed-methods approach involving both quantitative and qualitative research methods which are used in different paradigms and are anchored in the philosophical assumptions of those paradigms. The quantitative approach is employed within a positivist paradigm, while a qualitative method is applied within an interpretive paradigm (Mottier, 2005). The pragmatic approach does not engage in a debate over the conflicting assumptions of the research paradigms, but rather applies them pragmatically to answer research questions. Given the purpose of this study and the nature of the research question, a mixed-methods research design was felt to be appropriate for this research. Specific quantitative and qualitative research methods have therefore been used at different stages in this research to best answer the research sub-question(s). In this way both statistical and thematic data analysis techniques are applied to explain and interpret the quantitative and qualitative data respectively (Teddlie & Tashakkori, 2009). The rationale for this decision is further discussed in the method sections of Chapters 4-6.

Gelo *et al.*, (2008) suggest that research is placed along a qualitative-quantitative interactive continuum. With this understanding, this research has occupied various positions on this continuum at each stage of the research in order to best answer the research sub-questions. The research aims to contextualise the role of waste data in the South African context, and seek understanding of the influence of data on behaviour. This is achieved through both hypothesis-building and hypothesis-testing (Gelo *et al.*, 2008; Teddlie & Tashakkori, 2009).

1.5. Limitations of the study

This research is limited to those South African public (municipalities) and private waste organisations that are participating in the SAWIS. In particular, those organisations that submitted data to SAWIS in 2005-2006 and in 2009-2010. In 2005-2006, ten organisations (7 private, 3 municipal) participated in this research, through the piloting of SAWIS. Together, these pilot organisations operated a total of 16 waste facilities (waste landfills, treatment facilities or reprocessing facilities) in two provinces in South Africa (Eastern Cape and Mpumalanga). In 2009-2010, 40 organisations (14 municipal, 26 private) submitted data to SAWIS, from six different provinces. Not all organisations were available to participate in the research, and as such, interviews were conducted with 44 respondents (15 municipal, 29 private) from 31 organisations.

Participating organisations represent a small sample of the total number of operating waste facilities in South Africa. Participating landfills represent an estimated 12-13% of currently operating landfills in South Africa which are required to submit data to SAWIS. With no national data on the total number of operating waste treatment facilities or waste reprocessors, it is not possible to comment on the percentage of these activities reporting to SAWIS, however it is also considered to be low. In total it is estimated that <10% of known operating landfills, treatment facilities and reprocessors currently submit data to SAWIS and have participated in this research.

Although the total number of participating waste organisations in 2011 is small, they are believed to be a good representation of available organisations, and as discussed in **Chapters 4 and 5** able to generate statistically significant results. Participating municipalities included both metropolitan (type A) and local municipalities (type B). Private waste organisations included both large multi-national organisations and small entrepreneurial enterprises. While sampling of these organisations has been purposeful (Maxwell, 2005), which serves the purpose of this study, it is believed that the results do reflect broader issues currently experienced in the South African waste sector.

1.6. Structure of the study

The research has been completed by means of six stand-alone, but inter-connected journal papers (**Chapters 2-7**). Each paper continues from and adds to the knowledge provided in the previous paper, and in so doing inductively builds a conceptual model that supports the collection, analysis and interpretation of the research data. The papers are presented in the

following sections as separate chapters, each with its own abstract, introduction, method, results, discussion, conclusion and reference sections. These papers are preceded by this introductory chapter (**Chapter 1**) which provides some background to the problem, the need for this research and the research questions.

Understanding the research question and sub-questions has been a six-year journey (**Figure 1-2**) from the early pre-SAWIS development research in 2005 (**Chapter 2**), through piloting of the SAWIS in 2006 (**Chapter 3**) to evaluation of SAWIS data usage five years after implementation in 2010/11 (**Chapters 4-7**).

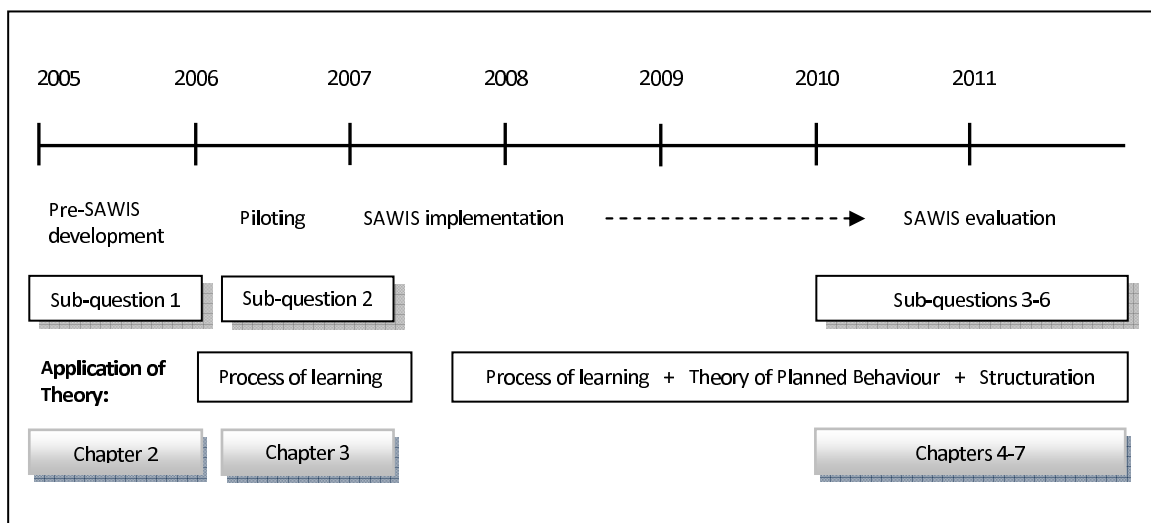


Figure 1-2. Timeline of research into the SAWIS and the application of theoretical frameworks in addressing the research question

Chapter 2, which addresses the first sub-question, deals understanding the needs for waste data in South Africa, and in particular the waste data needs of local, provincial, and national government. Based on data collected in 2005-2006, the research findings form the basis for the establishment of SAWIS. The need for waste data highlights the potential for this data to change behaviour, i.e. are the data needs aligned with key waste management issues facing the three spheres of government? Chapter 2 has been published as *Godfrey, L. (2008). Facilitating the improved management of waste in South Africa through a national waste information system. Waste Management 28 (9): 1660–1671.*

Chapter 3 addresses the second sub-question regarding the role of waste data in managing waste in public and private organisations. The empirical study, undertaken towards the end of the piloting of SAWIS in 2006, makes use of a preliminary theoretical framework of learning (Miller and Morris, 1999) to interpret the findings of the qualitative data. The research provides

preliminary results of the potential for waste data to influence behaviour in South African public and private waste organisations. Chapter 3 has been published as *Godfrey, L. and Scott, D. (2011). Improving waste management through a process of learning: the South African waste information system. Waste Management & Research, 29(5): 501–511.*

The low number of participating organisations in the 2006 SAWIS pilot project meant that quantitative methods were unlikely to provide statistically significant results. The sample size was too small to apply certain statistical methods and certainly to fit complex models such as the learning-behaviour theoretical framework, and hence the collection of only qualitative data for the paper presented in Chapter 3. The potential for application of statistical methods were improved in the 2011 empirical study due to the increased sample size, which allowed for the collection of both quantitative and qualitative data. In **Chapter 4** (*journal paper 3*), Miller & Morris' (1999) theory of the process of learning is applied again to understand the third research sub-question around the influence of waste data on knowledge, this time using a mixed-method research design.

Chapter 5 expands on the preliminary theoretical framework of learning by combining it with Ajzen's theory of planned behaviour (Ajzen, 1985). Both quantitative and qualitative data are used to explore the fourth sub-question regarding the influence of waste data on behaviour.

The evidence presented in **Chapters 4** and **5** highlighted a number of barriers to action not accounted for by the combined learning-behaviour theoretical framework. **Chapter 6** explores these barriers to implementing good waste management practice in South Africa. Recognising the importance of societal context that shapes waste behaviour in South Africa, **Chapter 7** presents a meta-level theoretical framework as a conceptual model of the knowledgeable, situated actor. By embedding the linear learning-behaviour action theories within structuration theory, the author has inductively and pragmatically built a refined theoretical framework over the course of the research, which allows for a better understanding of the research question and explanation of the research findings.

The research is summarised in **Chapter 8**, which concludes with a discussion of the theoretical contributions to the debate on the relationship between data, knowledge and behaviour within the social context of a developing and transforming country, and the practical recommendations for waste management in South Africa.

CHAPTER 2: THE NEED FOR WASTE DATA

“FACILITATING THE IMPROVED MANAGEMENT OF WASTE IN SOUTH AFRICA THROUGH A NATIONAL WASTE INFORMATION SYSTEM”

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2.1. Abstract

Developing a waste information system (WIS) for a country is more than just about collecting routine data on waste; it is about facilitating the improved management of waste by providing timely, reliable information to the relevant role-players. It is a means of supporting the waste governance challenges facing South Africa – challenges ranging from strategic waste management issues at national government to basic operational challenges at local government. The paper addresses two hypotheses. The first is that the identified needs of government can provide a platform from which to design a national WIS framework for a developing country such as South Africa, and the second is that the needs for waste information reflect greater, currently unfulfilled challenges in the sustainable management of waste. Through a participatory needs analysis process, it is shown that waste information is needed by the three spheres of government, to support amongst others, informed planning and decision-making; compliance monitoring and enforcement; community participation through public access to information; human, infrastructure and financial resource management; and policy development. These needs for waste information correspond closely with key waste management challenges currently facing the country. A shift in governments approach to waste, in line with national and international policy, is evident from identified current and future waste information needs. However, the need for information on landfilling remains entrenched within government, possibly due to the poor compliance of landfill sites in South Africa and the problems around the illegal disposal of both general and hazardous waste.

Keywords: waste information system, needs, challenges, government

2.2. Introduction

The South African Government identified in the late 1990s the need to develop pollution and waste information systems (WIS) to support the implementation of pollution and waste reduction measures, and effective integrated waste management (RSA, 2000a). However, research has shown that for information systems to be sustainable, one must understand the underlying motivations or needs of key stakeholders (Heeks, 2002; Lafontaine, 2000; Moussa and Schwere, 1992). This poses two questions – ‘how can the needs of government direct or shape the development of a sustainable WIS?’ and ‘how can an information system support effective integrated waste management?’

This paper aims to evaluate two hypotheses within the context of the young South African democracy. The first hypothesis is that the identified needs of government will provide a platform from which to design a national WIS. The second hypothesis is that where a need for waste information is highlighted, it reflects a greater, unfulfilled need in the sustainable management of waste – a need, which if fulfilled through the WIS, has the potential to lead to the improved management of waste in the country.

Since the WIS is seen as a tool of government, this paper focuses specifically on the needs of government – local, provincial and national – and does not consider the needs of non-governmental organisations (NGOs), community based organisations (CBOs) or industry. It is felt that introducing the needs of non-government role-players may divert the focus of the system to one which is either more onerous in terms of NGOs needs or too lenient in terms of industry’s needs.

2.3. Materials and methods

Two methods were used to assess the waste information needs of the South African Government – participative workshops and postal questionnaires. Workshops were held with key individuals responsible for waste management within the national and selected provincial government departments, while a postal questionnaire was sent to all nine provinces and 284 local government departments.

2.3.1. Sampling and data collection

The target population for the workshops was government officials responsible for waste management in the national and provincial departments of environment. Due to the

geographical distribution of provincial departments and the associated cost of holding workshops with all nine provinces, purposeful non-probability sampling (Maxwell, 2005; Leedy and Ormrod, 2005) was applied. The criterion (Neuman, 2000) used for sampling provinces was whether they had developed, or were in the process of developing, a WIS. The reason for non-probability sampling was to ensure a focused input that best reflected the waste information needs of provincial government. Of the nine provinces in South Africa five were, at the time of the workshops (October 2004–January 2005), to some degree involved with WIS development or implementation. The five provinces selected for workshops had an understanding of the role that a WIS could play in the integrated management of waste. The remaining four provinces had not actively engaged with the concept of a WIS. A review of the selected provinces (Free State, Gauteng, KwaZulu-Natal, Mpumalanga and the Western Cape) showed that both urban and rural provinces were selected, in other words, provinces facing different waste management challenges.

Although it is recognised that postal questionnaires typically provide a low response (Rea and Parker, 1992), often less than 20% or 30% (pers comm., Koen, 2006), it was considered the only feasible option for assessing the needs of local government, due to the large geographical distribution of respondents (Brynard and Hanekom, 1997). The entire population of local government departments responsible for the management of waste was included in the postal survey, providing a census (Henry, 1990) of waste information needs across local government. Postal, self-administered questionnaires (Neuman, 2000) were sent to the waste management departments in all 284 municipalities, comprising 231 local municipalities (Category B), 47 district municipalities (Category C) and 6 metropolitan municipalities (Category A). The questionnaire was distributed to all municipalities and provinces on 1 December 2004, with two follow-up requests made to municipalities in July 2005 and October 2005.

2.3.2. Method

A participative approach was adopted for the workshops to promote input from all delegates (Godfrey, 2005). Each waste management official, representing middle and senior management, was requested to provide two responses (on cards) as to why they needed a WIS. All cards were collected and, through a participatory approach, clustered into themes. Unless clarity was required, all responses were treated anonymously to allow participants the freedom to express their needs and concerns. The findings of each workshop were written up and made available to stakeholders for review and comment, to ensure that the needs had been accurately captured. All identified needs, grouped by theme, were placed in a spreadsheet for further analysis.

It was recognised, upon analysis, that two types of ‘needs’ were provided – *why* we need a system, and *what* data we need in that system. As such the needs were further clustered into *why*’s and *what*’s, the *why*’s providing key themes as to the needs of national and provincial government and the *what*’s providing insight into the specific areas of waste management which are priority concerns to government, i.e. generation, minimisation/reuse/recycling, transportation and final disposal (treatment or landfilling).

The intention of the postal questionnaire was to gather information on the current waste data and information practices in municipalities, the use of currently collected waste data and the perceived value of waste data, as a basis towards understanding the waste information needs of local government. The questionnaire (**Annexure 1**) posed a total of 31 questions (16 open and 15 closed) (Neuman, 2000) on the current collection of waste data; the types, frequency and reliability of data collected; the purpose for which data are collected; the means of storage of collected data; the availability of integrated waste management plans (IWMPs) and supporting data; the approach to current planning and decision-making; the presence of existing environmental and/or WIS; the need for access to waste information; the role-players in the provision, collection and maintenance of such waste data; and any plans to develop or implement a WIS. So as not to lead the respondents, specifically with regard to government waste information needs and to allow for maximum variability regarding possible needs, these specific questions were posed as open questions.

In an attempt to make the questionnaire ‘user friendly’ and easy to complete, thereby potentially maximising the return rate, a number of factors were considered in the questionnaire design. These included, amongst others, questionnaire length, use of language, avoidance of leading questions, clarity of instructions, layout and aesthetics (Leedy and Ormrod, 2005).

2.4. Results and discussion

2.4.1. Waste information needs

2.4.1.1. National and Provincial Government

The White Paper on Integrated Pollution and Waste Management (IP&WM) (RSA, 2000a) identifies the role of national government as being one of providing leadership and guidance to provincial environmental departments and municipalities through the development of policy, strategy and legislation; through coordination; enforcement; dissemination of information; participation and appeals; monitoring, auditing and review; and capacity building. As such the role of national government is one of a strategic nature, providing guidance and leadership in

the management of waste in South Africa. Provinces, on the other hand, play an important role in implementing national strategies and are responsible for the monitoring and enforcement of pollution and waste management issues within their province (RSA, 2000a).

The priority needs for waste information by national and provincial government, as identified from the participative workshops are outlined in **Table 2-1**. These needs largely reflect this strategic role of national and provincial government.

Table 2-1. Desired need for information by national and provincial government.

Desired use	Response	
	n	%
Planning	53	37.6%
Compliance & enforcement	22	15.6%
Public access to information	15	10.6%
Decision-making	11	7.8%
Policy development	9	6.4%
Monitoring	9	6.4%
Budgeting, billing & financial management	8	5.7%
Capacity building	3	2.1%
Strategy development	3	2.1%
Business development	3	2.1%
Reporting	2	1.4%
Job creation	2	1.4%
Research	1	0.7%

With regard to the specific areas of waste management (the *what's*), the emphasis of the needs for waste information were found to be on waste disposal (40.0%), followed by minimisation, reuse and recycling (23.5%), waste generation (23.5%) and waste transportation (13.0%). Although there has been a shift in focus locally (DEAT, 1999) and internationally away from end-of-pipe disposal and treatment solutions towards waste minimisation, reuse and recycling, the emphasis for waste information is shown here to remain predominantly on waste disposal. This is relevant at local government, with disposal being a basic service delivery issue. However, it is surprising at national and provincial government where one would expect a more strategic approach to waste management, in line with national and international policy. This focus on waste disposal by national and provincial government, may be due to the current problems concerning the illegal dumping of waste, the mismanagement of waste disposal sites and the lack of compliance of disposal sites within South Africa.

2.4.1.2. Local Government

The Constitution of South Africa (Act 108 of 1996, Section 152(1)) (RSA, 1996) and the White Paper on IP&WM (RSA, 2000a) identifies the role of local government as ensuring the provision of waste management services, waste disposal facility management, and the promotion of a safe and healthy environment.

In terms of local government needs, 99 unique questionnaire responses were received from 34.9% of municipalities in South Africa (**Table 2-2**). This response rate was increased from an initial 23.2% to 29.6% to 34.9% by means of telephonic and postal reminders. For a postal questionnaire, such a response is considered above average however, it does raise questions as to the representativeness of the responses. One may argue that only those municipalities currently collecting waste data would respond to such a questionnaire, thereby skewing the results to a more favourable position regarding waste data collection (municipalities not collecting data may not respond due to a fear of possible ramifications). An analysis of early and late responses (Rogelberg and Luong, 1998), showed that 64.6% of municipalities who responded early (<16 weeks) to the questionnaire were collecting data, while 76.3% of municipalities who responded later (16–54 weeks), were collecting data. The results instead suggest a potential bias towards non-data collection, had the late (or potential non-responses) not been received. In addition 31.1% of respondents indicated that they were not collecting any waste data.

The highest percentage response was from the urban, industrial hub of South Africa, namely Gauteng Province with 73.3% of local, district and metropolitan municipalities responding to the questionnaire. The lowest response was from the rural North West Province with only a 12.0% response by municipalities. The distribution of responses from both urban and rural provinces, local, district and metropolitan municipalities, data collectors and non-collectors, suggests that although only a 34.9% response was obtained for the questionnaire, the results reflect limited bias and are largely representative of municipalities in South Africa.

With the questionnaire being addressed to the waste management department of the local municipality, it is believed that '*inaccessibility*' (Rogelberg and Luong, 1998) was one of the main reasons for non-response. Follow-ups showed that in many instances the questionnaire had not found its way to the relevant manager responsible for waste within the municipality.

Of the responses received from municipalities, 68.9% were collecting some form of data on waste management. Unfortunately 62.0% of the municipalities collecting waste data believe that the data they currently collect are unreliable.

Table 2-2. Response by municipalities to waste information needs analysis postal questionnaire (grouped by province)

Province	Local Municipalities			District Municipalities			Metropolitan Municipalities			Total		
	Total	Number of responses	Response as % of total	Total	Number of responses	Response as % of total	Total	Number of responses	Response as % of total	Total	Number of responses	Response as % of total
Gauteng	9	8	88.9%	3	1	33.3%	3	2	66.7%	15	11	73.3%
Mpumalanga	17	8	47.1%	3	1	33.3%	0	-	-	20	9	45.0%
Free State	20	10	50.0%	5	1	20.0%	0	-	-	25	11	44.0%
Eastern Cape	38	12	31.6%	6	4	66.7%	1	1	100.0%	45	17	37.8%
KwaZulu Natal	50	16	32.0%	10	6	60.0%	1	1	100.0%	61	23	37.7%
Northern Cape	26	7	26.9%	5	4	80.0%	0	-	-	31	11	35.5%
Western Cape	24	6	25.0%	5	2	40.0%	1	-	0.0%	30	8	26.7%
Limpopo	26	6	23.1%	6	0	0.0%	0	-	-	32	6	18.8%
North West	21	3	14.3%	4	0	0.0%	0	-	-	25	3	12.0%
Total	231	76	32.9%	47	19	40.4%	6	4	66.7%	284	99	34.9%

Of the municipalities collecting waste data, 74.6% are collecting data on landfills, 46.5% on waste generators (not waste generation), 33.8% on waste transportation, 14.1% on recyclers and 4.2% on waste treatment. The priority needs of local government largely reflect the mandated function of municipalities in South Africa. In terms of the Constitution (Act 108 of 1996) (RSA, 1996), municipalities are responsible for refuse removal, refuse dumps and solid waste disposal (Part B, Schedule 5). It therefore makes sense that the waste data reflect this focus on waste disposal to landfills and waste collection from generators.

There has been much debate as to whether a national WIS for South Africa should focus on the collection of waste information from generators or the collection of waste information from end-of-pipe disposers, e.g. landfill sites. There is perhaps no one, single answer in this debate, both pieces of information being necessary to close the waste generation–disposal loop. However, to meet the short- to medium-term needs of all three spheres of government an initial focus on disposal is proposed, in line with the needs of government.

Of those municipalities who indicated that they were collecting data, 31.0% were collecting data on both the waste source/destination and quantity, 25.4% only the waste quantity and 14.1% only the waste source/destination. The frequency at which data are collected by municipalities varies, with 21.1% of municipalities collecting waste data indicating that they collect data daily, 26.8% monthly, 8.5% annually, 4.2% quarterly and 8.5% on an ad hoc basis.

The method of storage of collected data by municipalities provides an indication as to its accessibility and potential for use. 83.1% of municipalities collecting data store their data in hardcopy format, e.g. reports, weighbridge printouts, etc. with only 39.4% of municipalities storing their data in electronic format, e.g. spreadsheets, databases or information systems. The storage of data and information in paper-based records is typical of developing countries (Mundy, 1996) making access and analysis of data difficult for decision-makers. The implementation of a WIS will therefore support municipalities in moving data storage from hardcopy to a more accessible on-line, electronic format of data storage and information recovery.

The current use of waste data by municipalities is reflected in **Table 2-3** with the emphasis being on waste management planning, financial management, reporting, landfill site management and resource management – typical operational requirements of a local government.

Table 2-3. Current use of information by local government.

Current use	Response	
	n	% ^(a)
Planning	28	39.4%
Budgeting, billing & financial management	23	32.4%
Reporting	16	22.5%
Landfill site management	13	18.3%
Human resource & operations management	10	14.1%
Monitoring	9	12.7%
Compliance & enforcement	9	12.7%
New development initiatives	6	8.5%
Decision-making	3	4.2%
Identifying & solving problems	2	2.8%
Recycling initiatives	2	2.8%
Environmental assessments	2	2.8%
Public access to information	2	2.8%
Capacity development	1	1.4%
Research	1	1.4%
Missing (non-respondents)	8	11.3%

^a As a percentage of municipalities currently collecting data.

Although planning is identified by municipalities as the main use of collected waste data (**Table 2-3**), data does not appear to be the main basis for planning (**Table 2-4**). 82.6% of municipalities currently collecting data indicated that they base their planning on ‘obvious problems’, 43.5% on issues identified by national or provincial government, 40.6% on what municipalities ‘perceive’ to be problems, 37.7% on what consultants identify as problems, 14.5% on educated guesses and only 50.70% on data and information. Therefore, of the municipalities collecting data, only half are actually re-using this data for strategic waste management. This is possibly due to the poor storage format of data, typically in hardcopy format, and the low confidence in collected data as discussed earlier. It is the opinion of the author that the limited use of data may also lie with the fact that few waste managers understand the value of data and know how to use data in their operational planning and decision-making.

Table 2-4. Basis for planning by local government

Basis for planning	%
	Response
Obvious problems	82.6%
Data and information	50.7%
Issues identified by national and provincial government	43.5%
Perceived problems	40.6%
Consultants identify as problems	37.7%
Educated guesses	14.5%

The desired future use of waste information by municipalities is given in **Table 2-5**, with the emphasis being on planning, public access to information, new developments, resource management and financial management – again typical operational requirements of a local government.

Table 2-5. Desired need for information by local government

Desired use	Response	
	n	% ^a
Planning	49	47.6%
Public access to information	20	19.4%
New development initiatives	15	14.6%
Human resource & operations management	13	12.6%
Budgeting, billing & financial management	12	11.7%
Monitoring	11	10.7%
Compliance & enforcement	10	9.7%
Recycling initiatives	10	9.7%
Landfill site management	9	8.7%
Decision-making	8	7.8%
Reporting	8	7.8%
Capacity development	3	2.9%
Environmental assessments	3	2.9%
Identifying & solving problems	1	1.0%
Missing (non-respondents)	22	21.4%

^a As a percentage of all municipalities who responded to the questionnaire.

The identified waste information needs (**Table 2-5**) should not be seen as isolated activities performed by government, since many of these needs are integral to a ‘cycle’ of waste management, as indicated in **Figure 2-1**, of which planning is seen as being the first and most important step. A cycle aimed at improving the management of waste in South Africa through the dissemination and use of reliable waste information.

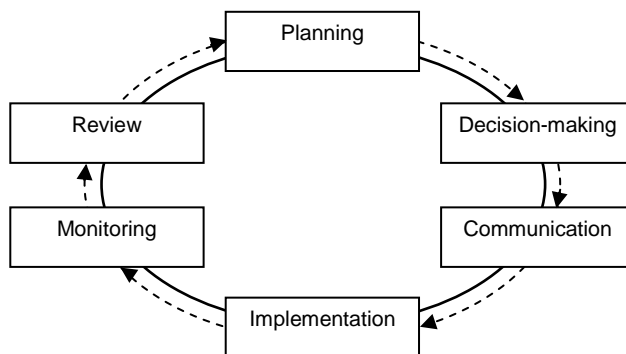


Figure 2-1. Cycle of management of waste by government

A comparison of the current uses (**Table 2-3**) and desired needs (**Table 2-5**) for waste information by local government as summarised in **Table 2-6** reflects a shift in ‘waste thinking’, with a move towards public access to information, planning, recycling and new developments. Not surprisingly, these positive shifts reflect a change in approach to the management of waste, a more strategic and integrated approach to waste management more in line with national and international policy and best practice.

Table 2-6. Shift in emphasis between current use of, and desired need for, waste data.

Identified Need	Response		
	Current Use	Desired Need	Deviation
Public access to information	2.8%	19.4%	16.6%
Planning	39.4%	47.6%	8.2%
Recycling initiatives	2.8%	9.7%	6.9%
New development initiatives	8.5%	14.6%	6.1%
Decision-making	4.2%	7.8%	3.6%
Capacity development	1.4%	2.9%	1.5%
To know	1.4%	2.9%	1.5%
Environmental assessments	2.8%	2.9%	0.1%
Research	1.4%	0%	-1.4%
Human resource & operations management	14.1%	12.6%	-1.5%
Identifying & solving problems	2.8%	1.0%	-1.8%
Monitoring	12.7%	10.7%	-2.0%
Compliance & enforcement	12.7%	9.7%	-3.0%
Landfill site management	18.3%	8.7%	-9.6%
Reporting	22.5%	7.8%	-14.7%
Budgeting, billing & financial management	32.4%	11.7%	-20.7%

2.4.2. Waste Management Needs

There is unfortunately very little written on the waste management challenges currently facing the three spheres of government in South Africa. The top two waste information needs – planning and compliance/enforcement – identified by national and provincial government are discussed below, within the context of their current waste management environment.

Planning is a very broad subject, ranging from strategic planning at national government, to basic operational planning at local government. According to McKinney and Howard (1998: 201) strategic planning is “*the strategy or means of carrying out a policy*”. In the case of South Africa, it reflects government’s plan of action or management framework for the implementation of the White Paper on IP&WM (RSA, 2000a) and the National Waste Management Strategy (NWMS) (DEAT, 1999). Information is an important component in this

planning and decision-making process (Roux *et al.*, 1997), however, since there is no routine, comprehensive collection of national waste data, it is currently not possible to support strategic waste management planning with reliable information.

South Africa has one of the most advanced constitutions in the world in terms of the protection of human rights (Kasrils, 2003), including the right to a safe and healthy environment. In addition, it has some of the most progressive environmental legislation in the world (WESSA, 2005; UNDP, 2003). However, government has typically been perceived to be unwilling and/or unable to enforce pollution and waste-related legislation (Lukey *et al.*, 2004; Seeliger *et al.*, 2003; RSA, 2000a; London and Rother, 2000). A public perception exists that government is unwilling and/or unable to “*come down hard on polluters*” (Lukey *et al.*, 2004). According to national government (DEAT, 2004a, p. 2), polluting companies will be “*pursued and held accountable should they not comply with their permit regulations.*” A review of landfill data collected by the national Department of Water Affairs and Forestry (DWAF) and the Department of Environmental Affairs and Tourism (DEAT) in 2005, shows that only 43.6% of the 1203 landfill sites in South Africa are known to be permitted (DEAT, 2006), and of those permitted, little to no information exists on their compliance with permit conditions. Of the non-permitted/unknown permit status landfill sites, in excess of 90% are thought to be municipal landfills. The biggest culprit of non-compliance in the landfilling of waste, it would therefore appear, is government itself. The need for cooperative governance between the three spheres of government, supported by reliable, accurate waste information is therefore imperative in improving the levels of compliance with waste and pollution legislation. Increasing compliance with environmental quality and protection legislation and authorisations has been identified as a strategic objective of DEAT (2004a), an objective to be supported by reliable, comprehensive information.

The top two waste information needs – planning and public access to information – identified by local government are discussed below, within the context of their current waste management environment.

“The greatest challenges we have as government in the delivery of infrastructure lies squarely in the proper alignment of planning processes. For municipalities, [Integrated Development Plans] should not be merely viewed as an annoying compliance matter, but rather as a planning instrument that will assist in the acceleration of the delivery of services. Not only do IDPs ensure accelerated service delivery, adhering to the IDP processes is in fact participatory democracy in action. Without proper planning, the project implementation phase will be delayed, resulting in slow service delivery. Experience has shown that ad hoc and

improperly planned projects never see their completion stage” (Hangana, 2006).

According to the Public Service Commission (PSC, 2005), sound strategic planning, budgeting and implementation are critical to ensuring effective service delivery by local government. It allows for development projects to be implemented “*as part of integrated, cohesive and coherent development strategies*” instead of in an ad hoc manner (Atkinson, 2002:25).

Local government is to a large degree immersed in planning processes, including the preparation of Integrated Development Plans (IDPs), Integrated Waste Management Plans (IWMPs), Environmental Management Plans (EMPs), Environmental Implementation Plans (EIPs) (DEAT, 2004b) and Service Delivery Improvement Plans (SDIPs) (PSC, 2005). According to the Municipal Systems Act (Act 32 of 2000: 38) (RSA, 2000c) all municipalities are required to complete Integrated Development Plans (IDPs) which lay out, amongst other things, the “*council’s vision for the long-term development of the municipality and the council’s development priorities and objectives for its elected term*”. Integrated waste management plans (IWMPs) are seen as a sector plan of the IDPs. According to the National Waste Management Strategy (DEAT, 1999) all municipalities are required to complete IWMPs for their area of jurisdiction (DEAT, 1999) by 2003, however, as yet there is no legislation which enforces the development of such waste plans. It is therefore not surprising that ‘*planning*’ ranks consistently as the highest current and future need for waste information by local government. However, as at mid-2005, only 58.3% of municipalities who responded to the questionnaire had completed, or were in the process of completing, an IWMP. Of those municipalities completing or having completed an IWMP, 78.3% indicated that there was sufficient data to develop the IWMP. However, since 81.7% of IWMPs have been completed by consultants, it is expected that much of this supporting waste data are currently held by private companies and not by government. As with the contracting out of the preparation of IDPs (Atkinson, 2002), the preparation of IWMPs by consultants raises concerns as to the ownership of the planning process and the likelihood of sustainable implementation. “*The end result of planning is a plan, which is nothing less than a carefully worked out programme of intended action*” (Botes et al., 1992: 189). A plan remains a plan until decisions have been taken and actions have been identified and implemented.

But planning can only be recognised as a valuable component in the management of waste, if waste is identified as a priority by local government. Waste has typically not been afforded the priority it deserves (RSA, 2000a; Godfrey and Dambuza, 2006). Understandably government is faced with basic social and livelihood issues such as access to food, employment, housing, water and sanitation, education and security. However, the mismanagement of waste has the potential to impact greatly upon human health and the environment and as such, is a critical

component of the services provided by local government. Planning is a critical aspect in the management of waste by local, provincial and national government, an aspect which to date has not realised its full potential – potential which may be supported through the collection of accurate, reliable waste information.

Public access to information is a constitutional right of all South Africans (Act 108 of 1996) (RSA, 1996) enabled through the Promotion of Access to Information Act (Act 2 of 2000) (RSA, 2000b). By increasing community awareness and understanding, it provides a mechanism for communities to participate in environmental planning, decision-making and policy development (Nauman, 2004; Kolominskas and Sullivan, 2004), in assessing the potential risks associated with local pollutant releases (Howes, 2001), and in placing pressure on industry and government to reduce emissions and discharges (Antweiler and Harrison, 2003; Kolominskas and Sullivan, 2004). The dissemination of information by government therefore provides a mechanism for supporting informed community participation in the management of waste. According to Kirby (1997:8):

“Freedom of information is important to justice . . . In a world of secrecy and opaque government, serious wrongs can occur which may never come to light. Freedom of information legislation is at once a means of casting the light of scrutiny into the dark corners of government and a contribution to a new culture of openness in public administration”.

Public access to waste information has however been slow to materialise. An Internet search of IWMPs in South Africa in June 2005, for example, yielded only three plans. Municipalities have typically been slow to include communities in the IWMP process and to make IWMPs available to the public for consultation and comment, thereby undermining the potential for communities to participate in the waste planning process.

2.5. Conclusions

As has been shown in this paper, the desired needs for waste information reflect some of the major issues facing national, provincial and local government, issues that reflect the more strategic roles of national and provincial government and the operational/service delivery role of local government. The top priority waste information needs of national, provincial and local government as identified in **Tables 2-1** and **2-5** are summarised in **Table 2-7**.

A WIS is therefore not just about collecting data for the sake of collecting data. It is instead a means to support and inform government to enable them to meet the waste management

challenges currently facing the country. It is however, also recognised, that the simple collection of data will not solve the waste management challenges currently facing the young democratic government of South Africa. Data and information is but one tool to be used in the armoury of government in improving the way waste is managed.

Table 2-7. The top 5 needs of national/provincial and local government

National & Provincial Government	Local Government
Planning	Planning
Compliance & enforcement	Public access to information
Public access to information	New development initiatives
Decision-making	Human resource & operations management
Policy development	Budgeting, billing & financial management

This paper has, through a participatory process, identified the needs of the three spheres of government with respect to waste information – needs which are shown to reflect waste management governance challenges currently facing South Africa. A brief discussion of the top two identified needs for waste information by national and provincial government and local government indicates that these are in fact challenges currently facing government with respect to the management of waste. These needs reflect the strategic issues of national and provincial government and the more operational issues of local government, in line with the roles and responsibilities of the three spheres of government with respect to the management of waste.

A shift in governments approach to waste is evident from the current and future needs for waste information. This shift is in line with national and international policy towards waste minimisation, reuse and recycling and sustainable waste management through sound waste management planning and the involvement of communities in planning through the dissemination of information. However, the focus on waste disposal to landfill and the need for information on landfilling remains entrenched within government, possibly due to the poor compliance of the majority of landfill sites in South Africa and the problems around the illegal disposal of both general and hazardous waste. Reviewing the current status of waste data collection has highlighted the diverse and varying approach across municipalities, in terms of the type of data, frequency of collection, etc., as well as the limited reuse and integration of this data and information into the management of waste.

Highlighting the needs of government with respect to waste information has also provided an understanding of the required framework for a national WIS, the requirements of role-players and data requirements. In particular, the needs analysis has identified two critical requirements –

the need to provide usable information to government to support the informed management of waste, while providing a mechanism to disseminate reliable waste information to the public.

While it is recognised that fulfilling all information needs identified by government is important to improving the management of waste in the country, it is also recognised that not all needs can be met in the short to medium term. It is also recognised that the needs reflect government's current approach/thinking towards waste management, which may change over time, resulting in a reprioritisation of waste information needs. As such a phased implementation approach to data collection has been identified (Godfrey *et al.*, 2005), which allows for the collection of data on immediate priorities, while at the same time accommodating medium- to long-term needs in line with growing national and international trends in waste management.

It is also recognised that there are certain waste management needs which a WIS may not be able to accommodate, e.g. enforcement and compliance which have been identified as major needs of government. Collecting reliable data on the management of waste creates a potential dichotomy in the collection of compliance and enforcement information. The knowledge that information will be used for legal compliance and enforcement has the potential to undermine the accuracy and reliability of data provided to a WIS, e.g. planning purposes. As such, the Department of Environmental Affairs and Tourism (Godfrey *et al.*, 2005) has recognised the need to develop two separate information systems, linked through a national registry of waste role-players.

There are many social, institutional and technical challenges currently facing the South African Government in the management of waste. While the implementation of a national WIS in South Africa is identified as a possible mechanism to support government in addressing these needs, it would be naive to think that the same challenges will not threaten the implementation of the WIS (Godfrey, 2006). The current and desired state of waste information management must be identified, and mechanisms put in place to close any gaps, thereby supporting the long-term sustainability of waste data collection in South Africa (Godfrey, 2006).

In conclusion, this paper has shown both hypotheses to be true: the identified needs of government have provided an understanding and insight into the design of the national WIS and the needs for waste information reflect greater, currently unfulfilled needs in the sustainable management of waste. These needs, which, if fulfilled through reliable, accurate waste information, has the potential to lead to the improved management of waste in South Africa.

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CHAPTER 3: THE CURRENT ROLE OF WASTE DATA

“IMPROVING WASTE MANAGEMENT THROUGH A PROCESS OF LEARNING: THE SOUTH AFRICAN WASTE INFORMATION SYSTEM”

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3.1. Abstract

Piloting of the South African Waste Information System (SAWIS) provided an opportunity to research whether the collection of data for a national waste information system could, through a process of learning, change the way that waste is managed in the country, such that there is a noticeable improvement. The interviews with officials from municipalities and private waste companies, conducted as part of the piloting of the SAWIS, highlighted that certain organizations, typically private waste companies have been successful in collecting waste data. Through a process of learning, these organizations have utilized this waste data to inform and manage their operations. The drivers of such data collection efforts were seen to be financial (business) sustainability and environmental reporting obligations, particularly where the company had an international parent company. However, participants highlighted a number of constraints, particularly within public (municipal) waste facilities which hindered both the collection of waste data and the utilization of this data to effect change in the way waste is managed. These constraints included a lack of equipment and institutional capacity in the collection of data. The utilization of this data in effecting change was further hindered by governance challenges such as politics, bureaucracy and procurement, evident in a developing country context such as South Africa. The results show that while knowledge is a necessary condition for resultant action, a theoretical framework of learning does not account for all observed factors, particularly external influences.

Keywords: Waste information system, learning, impact, developing country

3.2. Introduction

The environment outlook for South Africa for 2006 showed that levels of municipal waste service delivery only improved by 2.7% between 1996 and 2001, with almost 50% of the South African population not receiving a regular waste collection service (DEAT, 2006a). In addition 59.7% of the 231 local municipalities indicated that they could not perform their waste management functions (Godfrey and Dambuza, 2006). While it is acknowledged that there are many well operated sanitary landfill sites in South Africa in line with international best practice, of the 1280 known public and private landfill sites (general and hazardous) in the country, only 44.6% are authorized through permits (DEAT, 2006b). Of those permitted, compliance with permit conditions is seldom audited and often unknown. The result is that while pockets of compliance exist, waste is currently not being duly managed in South Africa, resulting in a negative impact on the environment which requires intervention (DEAT, 2006a,b; Bosman & Boyd, 2008). The need exists for public and private waste organizations to improve the effectiveness of current waste management practices.

The South African Department of Environmental Affairs and Tourism (DEAT), in its White Paper on Integrated Pollution and Waste Management (IP & WM), identified the need to develop waste information systems (WIS) to “*provide accessible information to interested and affected parties that will support effective integrated pollution and waste management*” and in so doing, “*ensure informed decision making, measure progress in policy implementation and enable public participation in the governance of integrated pollution and waste management*” (RSA, 2000:42). The DEAT developed the South African WIS (SAWIS) between 2004 and 2006. It has been shown that the impact of environmental information is increased through understanding the end users and their needs for information (Denisov and Christoffersen 2001). As such, the SAWIS was based on specific needs identified by key stakeholders from both public and private waste institutions (Godfrey, 2008). The identified needs for waste data include strategic requirements at national and provincial government level, with more operational needs at local government and at the waste facility level (Godfrey, 2008). For waste information to support policy objectives (RSA, 2000) and the needs of stakeholders (Godfrey, 2008), the routine collection of data must move beyond simple collection to also include data assimilation and interpretation, and conversion of resultant information to knowledge.

This paper explores whether, through the conversion of waste data to knowledge, these original intentions for a WIS can be fulfilled in a developing country such as South Africa. In particular the paper aims to explore the research question: ‘*Can the collection of data for a national waste information system, change the way waste is managed in South Africa, such that there is a*

noticeable improvement? The approach to the SAWIS is that municipalities and private waste companies collect basic waste data at the waste facilities; for example, tonnage of general municipal waste delivered by a vehicle to the landfill. This waste data is converted to waste information through a process of collation and analysis; for example, total monthly tonnage of general waste landfilled; by the relevant waste officer, and this information is then submitted to the SAWIS.

Unlike studies which have focused on the role of information technology, namely the waste information system, in influencing individual and organizational behaviour (Chiasson & Saunders, 2005; de Man, 2006), this research focuses on the waste data and information, and through a process of learning, changing personal behaviour. The role of data and subsequent information, in generating knowledge, is discussed in the next section and formulated into a preliminary theoretical framework, against which the research findings are evaluated in the subsequent sections.

3.3. Preliminary theoretical framework

3.3.1. Knowledge as a precursor to action

A dichotomy exists between theorists who propose that making data and information available to individuals has the potential to influence actions by building knowledge and capacity – the ‘information–action’ theory (Bruch, 2000; Denisov & Christoffersen, 2001; Denisov *et al.*, 2005; Stephan *et al.*, 2005), and those who argue that a tenuous relationship, if any, exists between knowing what to do and acting on that knowledge (Finger, 1994; Miller and Morris, 1999; Pfeffer & Sutton, 2000; Weiss, 2002). Knowledge is defined by Miller and Morris (1999:77) as the ‘*integration of information derived from data, plus theory that puts the information in the proper context, plus experience of how things work in the real world*’.

Environmental information disclosure, science communication and environmental education, which draw from behavioural psychology, are three disciplines which have provided significant theoretical contributions to understanding the impact of environmental information on decision-making processes (Weiss, 2002; Denisov *et al.*, 2005; Stephan *et al.*, 2009).

Information disclosure is a recognized environmental policy instrument capable of ‘eliciting’ or ‘inducing’ desired outcomes (Antweiler & Harrison, 2003; Kolominskas & Sullivan, 2004; Denisov *et al.*, 2005; Stephan *et al.*, 2009). Research has shown that information can make people aware of the consequences of their behaviour and influence their awareness, opinions,

attitudes and knowledge (Howes, 2001; Weiss, 2002; Denisov, *et al.*, 2005). In so doing, policymakers then rely on people to use this newly acquired information and resultant knowledge to change their behaviour so as to meet the required policy intention.

While information disclosure has been used internationally in many domains ranging from public health, energy conservation, environmental management to family planning (Weiss, 2002; Denisov *et al.*, 2005), perhaps the most well known example of successful information strategies, is the Toxic Release Inventory (TRI) implemented in the United States in 1986 in response to the chemical accident at a Union Carbide plant in Bhopal, India (Nauman, 2004; Stephan *et al.*, 2005). Based on the principles of community-right-to-know, the TRI requires that certain listed industries report on the quantity and types of pollutants released to air, water and soil, and transferred off-site for disposal, which are then made available to government and the public. The empirical evidence suggests that TRI information disclosure has had positive impacts in reducing the volumes of pollutants discharged to the environment, through raised industry awareness of wasteful processes (Howes, 2001; Kolominskas and Sullivan, 2004) and social pressure (Weiss, 2002; Antweiler & Harrison, 2003; Stephan *et al.*, 2009).

The proposition put forward by those researchers in favour of ‘information–action’, is that information can make people aware of the consequences of their behaviour and influence their awareness and knowledge regarding this behaviour (Howes, 2001; Weiss, 2002). The underlying assumptions in information strategies are that people respond to information; respond to information out of their own accord; that people have ‘limitless capacity’ to absorb new information; and that people have endless motivation to alter their behaviour based on what is considered ‘optimal behaviour’; and that knowledge generated through the internalization of information is linked to action (Weiss, 2002).

Unlike information disclosure strategies such as the TRI, the SAWIS does not make facility-specific information available to the public. As such, the issue of public pressure as a driver of change (Stephan *et al.*, 2009) is not considered within this research. Instead this research focuses on resultant change from only those actors involved in collecting the data and reporting the information to SAWIS. In addition, those actors expected to implement change, are not necessarily directly at risk from the waste, as in the case of vulnerable communities (Tietenberg & Wheeler, 1998; Barr, 2007). Unlike America, where implementation of the TRI has been largely successful (Stephan, *et al.*, 2005), this paper focuses on solid waste management specifically in the South African context as a developing country, and not broader pollution management. At the time of this research, reporting to the SAWIS was not regulated, but voluntary in nature, although regulations to enforce reporting to the SAWIS were under

consideration (RSA, 2009).

3.3.2. The process of learning

The process of learning (Miller & Morris, 1999) (**Figure 3-1**) allows for collected data to be assimilated, interpreted (converted to information) and together with the application of existing theory (which puts that information into the correct context) and experience of real world applications, builds knowledge (Allee, 1997; Miller & Morris, 1999; Poch *et al.*, 2004). Learning is considered to be a process of “*gaining knowledge, comprehension or mastery*”, “*acquiring or creating knowledge*” (Allee, 1997:50) or as a relatively permanent change in behaviour, or behaviour potential (Baron, 1995).

Miller & Morris (1999) note that decision-making today is often based on data and information ‘to the near-total neglect’ of knowledge, with information often being mistaken for knowledge (Moeletsi & Novella, 2004). According to Allee (2003:264), knowledge is considered as the “*capacity to act*”. Knowledge is therefore seen as being an important component of attitude formation and of behaviour.

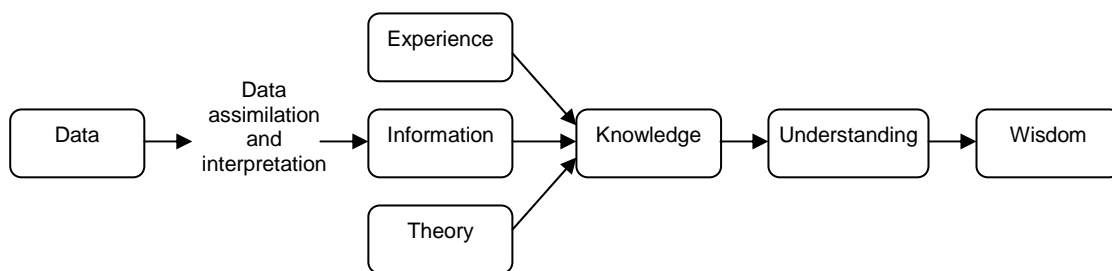


Figure 3-1. Process of learning (adapted from Miller & Morris, 1999).

Having adopted an inductive research approach to this work, the process of learning provides a preliminary theoretical framework for interpreting the case study data, discussed in the next two sections. The paper focuses on three sub-questions guided by the theoretical framework: *Do organizations have the ability to collect data on solid waste? Do employees have the ability to assimilate and interpret the data and through a learning process build new knowledge? Do employees (and organizations) have the ability to convert this knowledge into impact (potential to implement change in managing waste)?*

3.4. Materials and methods

According to existing research (Denisov & Christoffersen, 2001; Jones, 2001), the impact of information on resultant actions often cannot be directly observed or measured. This may be due to time lags between providing information and resultant action, and in singling out the impact of one piece of information from a multitude of behavioural influences. For this reason, this paper adopts an exploratory, interpretive approach so as to rather seek understanding through the application of the preliminary theoretical framework, specifically as it relates to waste management (Leedy & Ormrod, 2005). Due to the exploratory nature of this research, a detailed explanation of the research method, as outlined in the following sections, is deemed necessary.

3.4.1. Positionality

A postpositivist, interpretive research approach in the social sciences, recognises that the investigator and investigated are not independent entities (Mottier, 2005; Henning et al., 2004), and any knowledge gathered through the research is ‘marked by its origins’ and needs to be situated or positioned relative to both the researcher and that which is being researched (Rose, 1997). In so doing, it makes the position of the researcher known, thereby limiting the potential for overgeneralizing or universalizing from the research findings (Rose, 1997). This section presents the role of the author in the SAWIS pilot study.

In support of the development of the SAWIS, the system was piloted in two provinces in South Africa, Mpumalanga and Eastern Cape between 2005 and 2006. A review of the pilot project was conducted by the author at the end of the piloting period, to assess five elements fundamental to the long-term success of SAWIS, namely anchoring and ownership; capacity development; resource requirements; communication and outreach; and system sustainability. These particular elements are not discussed here, but are summarised in a report by the author to the Department of Environmental Affairs and Tourism (DEAT, 2006c) and refer to the sustainability of the SAWIS. The SAWIS pilot project review provided a unique opportunity to undertake a preliminary exploration of the potential for impact of data collected for the SAWIS on the way waste is managed in South Africa, as discussed in this paper.

It is recognised that access to specific individuals within organisations is often difficult to obtain, especially within government departments where access may be denied due to senior management or political concerns around highlighting internal governance weaknesses. Direct access to persons responsible for the management of waste and/or those responsible for the

implementation of the SAWIS within their organisations was facilitated by the author being part of the national government project team tasked with piloting the SAWIS, which made data collection easier. The author's involvement in the South African waste sector over the past 15 years, which resulted in her being known to most individuals who participated in the SAWIS pilot study, further facilitated engagement with respondents and supported the research approach.

3.4.2. Sampling

The municipalities and private waste companies participating in the SAWIS pilot study were identified by means of a set of predetermined selection criteria, which were developed to ensure that a fair and transparent process was followed in evaluating the suitability of the nine provinces in South Africa (Borg *et al.*, 2004, Fischer & Godfrey, 2005). The aim was to identify two suitable provinces and associated participating municipalities and private waste companies. The criteria for selecting the participating institutions were based on their suitability in terms of the SAWIS testing which therefore provided a purposeful sampling frame in terms of the research requirements. Based on the evaluation criteria, two provinces, Mpumalanga and the Eastern Cape, and three municipalities, Mbombela, Buffalo City and Nelson Mandela Metro were selected for piloting of the SAWIS. Seven private waste companies and three municipalities, operating a total of 16 facilities (waste landfills, treatment facilities or reprocessing facilities); and two provincial environmental departments, volunteered to participate in the study (**Table 3-1**). The SAWIS pilot project therefore allowed for a multiple case study design (Yin, 2003).

Table 3-1. Number of participating organisations and waste facilities

Organisation Type	Number	Number of waste facilities		
		Landfill	Treatment	Reprocessor
Eastern Cape				
Provincial Department of Environment	1	-	-	-
Municipal waste department (public)	2	5	-	-
Private waste companies	4	1	1	3
Mpumalanga				
Provincial Department of Environment	1	-	-	-
Municipal waste department (public)	1	2	-	-
Private waste companies	3	2	1	1
Total	12	10	2	4

3.4.3. Data collection

Case study based research provides a variety of means for data collection and evidence gathering; for example, direct observation, participant-observation, interviews, and the review of documents and artefacts (Yin, 2003). For the purpose of this research, primary qualitative data was collected. Such primary data included personal observations of SAWIS pilot project participants made during the course of the one year pilot project (September 2005 to November 2006); data collected through one-on-one interviews with waste officers in both public and private institutions; and the review of consultant reports prepared during the SAWIS pilot project, technical reports and government publications.

Interviews with waste officers from participating organizations were the main source of primary data. The interviews were conducted by the first author as part of the pilot project review task (DEAT, 2006c). Since the SAWIS was implemented in only selected pilot organizations that fulfilled certain initial requirements, limited persons were available to interview. A total of 19 interviews were held with representatives of 12 organizations (seven industries, three municipal and two provincial departments) (DEAT, 2006c). The number of participating organizations and resultant interviews provided a relatively small sample of respondents from appropriate organizations who were able to share insights into the successful piloting of the SAWIS. The organizational status of respondents ranged from senior line managers responsible for waste within provincial and municipal departments, to technical managers in municipalities, hospitals and private waste companies, to waste officers and clerks appointed by the municipalities or waste companies to oversee the collection and submission of data to the SAWIS.

For the purposes of this research, and given the qualitative approach (Coolican, 2004; Yin, 2003), data were collected by means of semi-structured interviews (Whitley, 2002). This instrument for data collection has the advantage of following an interview guide with specific themes related to the aim of the study. However, there was typically no specified order in which the topics or questions were covered (Whitley, 2002) given the exploratory nature of the study. This flexible approach gives the appearance of a guided conversation as opposed to a structured interview (Yin, 2003). Respondents were in this way provided with an opportunity to raise issues related to the research question which may not have been recognized prior to the interviews.

3.4.4. Analysis and interpretation

Data analysis involved an interpretive approach, whereby a large body of interview transcript

data were sorted and categorized into a small set of pertinent themes (Leedy & Ormond, 2005), making use of category trees (**Figure 3-2**) (Kitchin & Tate, 2000). In the thematic analysis, two techniques were chosen for interpretation of the research data; pattern matching and explanation building (Yin, 2003). In the case of ‘pattern matching’, the first author examined the collected data to see if they supported the preliminary theoretical framework and associated research questions (Whitley, 2002; Yin, 2003). The research question and sub-questions formed the basis for initially defining the three themes and the subsequent relationship between these themes (connection). In the case of ‘explanation building’, a particular type of pattern matching, the author used the transcribed data to find emerging patterns or themes, thereby building an understanding of the case (Spencer *et al.*, 2003; Yin, 2003). While the research was framed within a preliminary theoretical framework of learning (**Figure 3-1**) the interpretive approach allowed for the emergence of themes and sub-themes not originally identified in the interview schedule.

3.5. Results and discussion

The interpretation of the interview data focused on the aim of the paper, which was to gauge the likely impact of collecting data for the SAWIS on improving the way waste is managed in South Africa. As such, the results are discussed within the three broad themes. These being: the ability of organizations to collect waste data; the ability of employees to assimilate and interpret the data and generate new knowledge; and the ability of employees and organizations to convert this knowledge to impact.

3.5.1. Ability of organizations to collect data

With regard to the ability of organizations to collect data, the interviews revealed three sub-themes: differences between facility type (public or private); drivers to successful data collection; and constraints to successful data collection (**Figure 3-2**).

The interviews and review of documents highlighted that eight of the 12 organizations were already collecting some waste data prior to the SAWIS pilot project. What was evident from the interviews was that a difference existed between private and public facilities, particularly with regards to data collection prior to the implementation of the SAWIS. Only one of the five public institutions that participated in the pilot project had a prior data collection system in place, whereas all private facilities had some prior system for waste data collection (**Table 3-2**).

Private waste companies appeared to be generally more successful at collecting data than the

public facilities (hospitals and municipal landfills).

The drivers of data collection, as a sub-theme, were further explored with respondents. It was found that the main drivers for organizations having already implemented data collection systems prior to the piloting of the SAWIS were organizational, external to the respondent. These factors included financial sustainability, for example, revenue recovery (billing) and reduced operational costs; or environmental reporting obligations such as ISO14000, particularly where the company had an international parent company (**Table 3-2**).

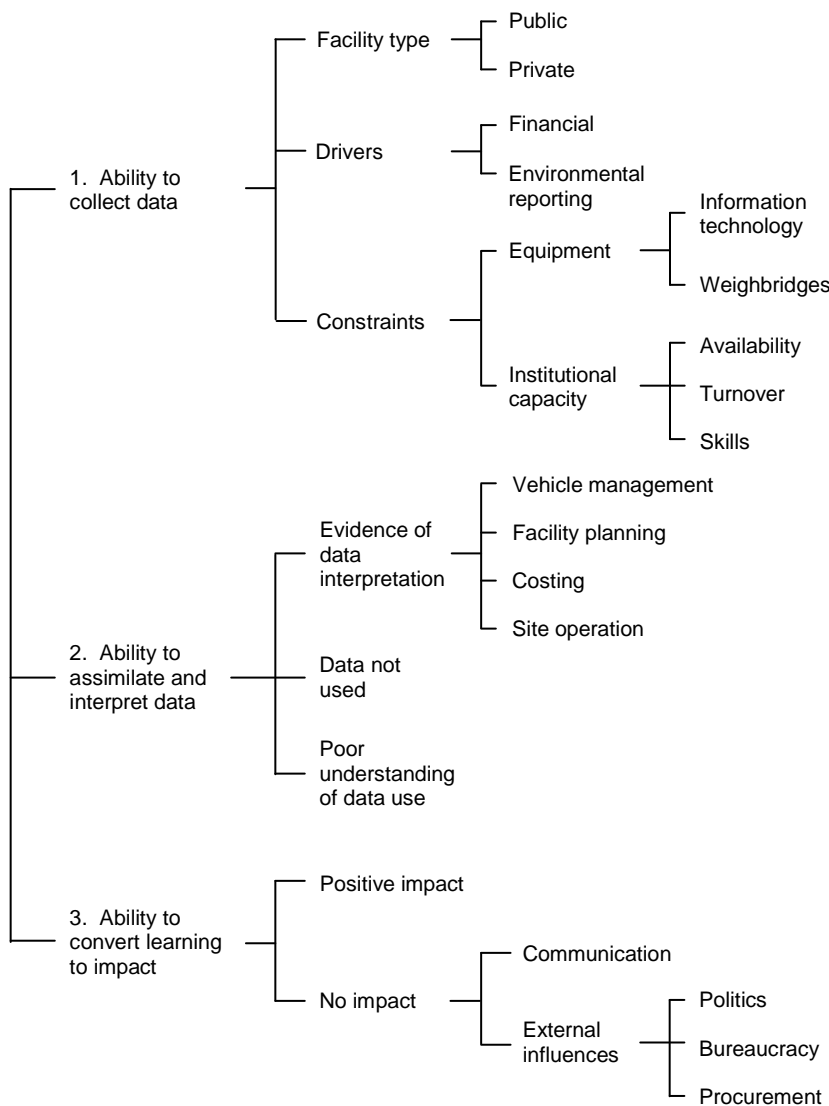


Figure 3-2. Summary: The ability to change the way waste is managed through data collection

Financial reasons for data collection were particularly evident among recycling companies who are paying to buy in waste [Respondent L, 1/11/2006]. Respondents from all of the recycling companies interviewed highlighted the importance of keeping sound records of the quantities of

waste purchased. As pointed out by the manager of a waste recycling facility “*every transaction has a value and therefore the value has to be recorded and the [waste] volume, so, you know, just through clear business sense you’ve got to contain that*” [Respondent J, 31/10/2006]. The manager of another waste recycling company highlighted, however, that it was not about collecting data, that the data collection was rather a product of collecting the waste. “*It’s not to get the data; it’s more to actually get the waste, because it’s a requirement of our business. We obviously keep data on that, but it’s really records from a business perspective*” [Respondent L, 1/11/2006]. The collection of waste data for business purposes also means that data has to be accurate and remain up to date, as stressed by the technical manager of a recycling company “*we know exactly what the waste is because we’re paying for it, so it’s accurate, and it’s kept up to date for our own records*” [Respondent M, 1/11/2006].

Table 3-2. Correlation between private/public and data collection practices

Province	Facility ownership	Prior data collection	Data collection driven by
Eastern Cape	public	No	-
	public	No (Partly)	-
	public	Yes	Financial - client billing
	private	Yes	Financial - client billing; reduce operational costs
	private	Yes	Financial – pay for waste (recycled); ISO 14000
Mpumalanga	private	Yes	Financial – pay for waste (recycled)
	private	Yes	Financial – pay for waste (recycled)
	public	No	-
	public	No	-
	private	Yes	ISO 14000; Legislation (human tissue)
	private	Yes	ISO 14000 (International parent) Financial – reduce operational costs
	private	Yes	ISO 14000 (International parent) Financial – reduce operational costs

The importance of data on waste tonnages was also highlighted by all three private landfill operators. As pointed out by the technical manager of a private waste landfill site “*well, we want to reduce our waste and if you can save on your waste, you save money. The operating costs at [the] landfill is expensive and if we can expand the lifespan of [the] landfill the better for us, we can save a lot of money*” [Respondent R, 24/10/2006]. This drive for data collection in private waste companies is based on a paradigm of financial sustainability. This was emphasized by the manager of a private landfill facility that “*there has to be a cost focus, economic focus, very much so, because if you are not performing, then the shareholders want to know why*” [Respondent F, 31/10/2006].

Environmental reporting obligations, for example, ISO 14000, or reporting to international holding companies was also found to be a driver of data collection among the majority of private organizations (**Table 3-2**). The technical manager for an industry running its own private landfill site noted that *“fortunately because ISO expects you to have that balance, what’s coming in and what’s going out, it must balance otherwise you can’t give evidence of what happens to your waste. And that’s where we had to implement [data collection] systems to make sure that we comply”* [Respondent R, 24/10/2006]. The same respondent also noted the pressure placed on their company from their international parent holding company. The parent company regularly requires information on waste management and sends in audit teams to assess levels of waste management compliance within the organization.

The third of the sub-themes is the current constraints to data collection within both private and public waste facilities. These constraints to data collection hinge specifically around lack of ‘equipment’, particularly IT (computers, internet and email connectivity) and ‘institutional capacity’ (availability of staff, the high staff turnover experienced and a shortage of skills within the organizations to collect and interpret the data) (**Figure 3-2**). The constraints created by a ‘lack of equipment and institutional capacity’ are not unique to this study but were also found in an independent research project conducted by the author, on challenges facing local government, which adopted a systems approach to exploring institutional constraints facing waste management in local government (Godfrey and Oelofse, 2008).

Equipment constraints hinged around two specific issues, the lack of computers, email and internet, typically within municipalities, and the lack of weighbridges at landfills to capture data on waste entering facilities. The lack of IT equipment appeared largely to be a problem within municipalities in both provinces. Officials within municipalities were often found not to have computers, and where they did have computers, they did not have email or internet connectivity [Respondent A, 30/10/2006; Respondent N, 23/10/2006]. This makes the transfer of data to the SAWIS difficult, and often means that data has to be transferred in hardcopy by fax or mail. The lack of computers means that data may not be quantitatively analysed or interpreted, which has the potential to negatively impact upon the internalization of this information and the potential for generation of knowledge. A further constraint is the lack of equipment at waste facilities such as weighbridges for accurately recording tonnages of waste [Respondent A, 30/10/2006; Respondent B, 30/10/2006]. This impacts upon the reliability and accuracy of data collected for the SAWIS, which impacts upon the quality of use of the data (**Figure 3-2**).

From the interview data, institutional capacity was seen as a predominant constraint within municipalities. One of the reasons for this lack of capacity is the high turnover of government

officials (Nauman, 2004), a challenge currently facing South Africa (Godfrey, 2007), and confirmed by respondents in both provinces. A provincial waste officer observed that *“the people that are collecting [the data], today they’re in, tomorrow they’re out. So there’s no consistency”* [Respondent N, 23/10/2006]. The manager for waste in the province also noted that *“the turnover is... just unbelievable of staff within the department, especially at a regional level”* [Respondent C, 30/10/2006].

It is not only having all available positions filled that is important, but also having staff with the appropriate technical skills [Respondent P, 23/10/2006]. This lack of skilled capacity within public facilities was also identified by the provincial waste officer who noted that municipal employees responsible for the collection of data at waste facilities often did not have a Grade 4 school qualification. In instances, general cleaners were assigned the responsibility of collecting the waste data [Respondent N, 23/10/2006]. This lack of skilled capacity at waste facilities was seen to impact upon issues as simple as staff not being able to identify the type of waste being generated or received, or estimating the tonnages of waste carried by vehicles entering municipal landfill sites [Respondent A, 30/10/2006].

3.5.2. Ability of employees to assimilate and interpret the data and build new knowledge

The second theme is around the ability of employees to assimilate and interpret the collected waste data into information, and then build new knowledge through a process of learning, which would give them the ability to act. The interviews revealed three sub-themes: evidence of data interpretation; data not used; and poor understanding of data use (**Figure 3-2**). With regards to the first sub-theme, the interviews showed that in instances, respondents have assimilated and interpreted the collected waste data (generating information), and in so doing, recognized areas of intervention, or possible uses of the information to improve the way in which waste is managed within the facility. Evidence of particular applications of the information, include managing the vehicle fleet; planning for current and future waste facilities; costing of operations; and ongoing site operation and maintenance.

In one instance, a municipal landfill site had records on vehicles entering the landfill for the first time since data collection for SAWIS began. The assimilation and interpretation of the collected data is evident in the information provided by Respondent O (23/10/2006) *“I can see now why this vehicle for the time [is] not entering the site ... it’s broken down and they didn’t fix it. I told () the other day, now we can see the management side of the vehicle maintenance”* [Respondent O, 23/10/2006]. This data on vehicles entering the site provided the same respondent the opportunity to monitor the operation of their transfer station.

“I know now for a fact, the transfer station is not operating properly for the last month, because all the rear end compactors [are] going out to the landfill site. And that’s a lot of extra cost. Now normally on our landfall site it’s only the garden refuse trucks and the roll on vehicles [which are] supposed to enter the landfill site, now all the tractors and trailers and everything is now entering the landfill site” [Respondent O (23/10/2006)].

Respondent O (23/10/2006) also noted that the limited data the municipality had to work with prior to the SAWIS pilot project had been a ‘thumb suck’.

Many municipal landfill sites are currently not charging for waste disposal, due to a lack of capacity or fear of increased illegal dumping (Godfrey & Nahman, 2008; Godfrey & Oelofse, 2008). While all participating private landfill sites, and those public landfills in the larger metropolitan municipalities, were charging for the disposal of waste at the time of this research, one of the local municipalities which participated in the pilot did not charge. Because of data collection for the SAWIS, this municipality was now looking into disposal tariffs for the new planned landfill site. Respondent O (23/10/2006) felt that for the first time they now know *“the tonnage [of waste] that’s going in, so [how] much we must ask per ton, to balance the books of the new landfill site.”*

The application of data for site operation was identified by respondents from both public and private waste facilities. Operational issues for landfill sites centred on managing remaining airspace in landfill sites [Respondent O, 23/10/2006; Respondent R, 24/10/2006; Respondent S, 24/10/2006] as well as planning the airspace needs for future landfills [Respondent O, 23/10/2006].

The interviews similarly highlighted the fact that some organizations do not use the data after having collected it, and therefore have no concept of the usefulness of having the data available to them, or alternatively have a poor understanding of the potential use of this data. The technical manager of a waste recycling company that previously commented on the importance of collecting data as part of their business accounting systems, later pointed out that he *“personally [doesn’t] use [the waste data] for anything else, the only reason I ever request it is for the reporting [to SAWIS] and I know that it’s not something that is reported on regularly because whenever I ask [my company] to provide me with it, they’ve got to go and run reports. Download it, collect it, they don’t have that information on hand”* [Respondent H, 31/10/2006].

3.5.3. Ability of employees and organization to convert this knowledge to impact

The third theme revealed in the interview data is the ability of employees and organization to convert this resultant knowledge to impact, and in so doing bring about change in the way waste is currently managed. The interviews highlighted few areas of direct positive impact leading from the SAWIS data collection, as well as areas of no or little noticeable impact in operations (**Figure 3-2**).

Positive impacts noted by respondents included the placement of new staff at landfill sites to improve the flow of vehicles onto the site, thereby freeing up existing staff to collect the required data. In one particular case, the security guard at the entrance of the landfill had previously been tasked with both directing vehicles to the tipping face as well as collecting waste data [Respondent B, 30/10/2006]. The research also revealed a more aggressive drive towards finding new sources of recyclables for one of the recycling companies [Respondent M, 1/11/2006]. However, since the research showed that all participating private waste companies had already been collecting data prior to the SAWIS, it is difficult to distinguish the impact of the SAWIS data collection from that already implemented through existing management practices.

According to the provincial waste officer [Respondent N, 23/10/2006] the collection of data by the municipality has not had any positive impact on landfill management “*if it did really, they would have even put a new fence up*”. Even at the public hospitals, data collection has had no impact on waste management: “*No ways, no difference [at the hospitals]. It's just that they're collecting it because we want that information..., they're not utilizing it for any of their benefits*” [Respondent N, 23/10/2006].

In instances, collected data was not being used at all after submission to the SAWIS, with no potential to generate knowledge or cause change. As pointed out by the technical manager of a waste treatment facility: “*I've no [use for the data] at the moment, but I've got it there should we [need it]*” [Respondent Q, 23/10/2006]. This was confirmed by a respondent from provincial government who also noted that the data “*was not necessarily [being used] right now*” [Respondent A, 30/10/2006].

This raises the question as to why in certain circumstances individuals with acquired knowledge act on that knowledge to implement changed waste practices, while in other instances, this acquired knowledge does not lead to impact? According to Miller and Morris, (1999:74) “*there is a commonly held myth that providing individuals or groups with information will lead them to*

appropriate personal and organizational actions and performance, but this is far from true". According to Pfeffer & Sutton (2000), while information and knowledge are 'crucial to performance', knowledge of an issue is often not sufficient to cause action: "*there is only a loose and imperfect relationship between knowing what to do and the ability to act on that knowledge*" (Pfeffer & Sutton, 2000:25). This frequent inability to transfer knowledge of what needs to be done into action or behaviour which is consistent with that knowledge, is referred to by Pfeffer & Sutton (2000) as the 'knowing-doing gap' or the 'performance paradox' (Cohen 1998 in Pfeffer & Sutton, 2000). While it was believed that the 'knowing-doing gap' was due to a lack of personal knowledge, research conducted by Pfeffer & Sutton (2000) suggests that while personal knowledge is important in ensuring action, it is not as important as having management systems and practices in place. According to Pfeffer & Sutton (2000) the gap between knowing and doing is more significant than the gap between ignorance and knowing. This is due to the fact that considerable knowledge already exists, which is either already known to an individual, or can be readily sourced, yet lack of implementation persists.

This lack of impact from waste data collection to changed waste practices may result from a communication 'gap' between those who collect and interpret the data, and those who have the responsibility and ability for decision-making and effecting change. This is evident in the response provided by a municipal officer: "*I send [management] the monthly data sheet. I don't know if they look at it at all, but I send it through to them as well*" [Respondent O, 23/10/2006]. This highlights that while data collection may result in new information generation, if the information is not communicated to the decision-makers within the organization, the potential for resultant impact may be lost.

The interviews also highlight a number of external factors which make it difficult for staff within municipalities and private waste companies to use the acquired knowledge to improve the management of waste; for example, South Africa's political situation and approach to waste management, organizational bureaucracy particularly within municipalities, and ineffective and inefficient organizational procurement policies. These external factors, which are further discussed in the following pages, hinge around governance, due particularly to the low priority often given by politicians and senior government officials to waste in South Africa. According to Howes (2001), the long-term sustainability of any pollutant and waste information system is dependant foremost upon the political will of the country to support such initiatives:

"But again, it's this political willingness to turn things around at a local level, I mean it's worse at a local level than at provincial level. If there is no political buy-in on any activity it will not fly at a local level and that's just a reality. All these processes must have a political endorsement through their councils before it moves

otherwise it just doesn't go" [Respondent C, 30/10/2006].

The external influences and apparent frustrations of politics, bureaucracy and procurement were only noted by respondents from municipalities and not from private waste companies. Long approval processes and the centralization of decision-making to councils and municipal managers were noted by waste officials:

"It becomes difficult to go around the bureaucracy [in the municipality], because sometimes it has to go through the municipal manager for signature, before it goes to him, he [wants] to make sure that a legal adviser is happy with the content and then once they are happy with that, then it must go through the council, and it takes months" [Respondent B, 30/10/2006].

The frustration experienced by municipal waste officers who need to wait for lengthy bureaucratic approval processes was noted by Respondent C (30/10/2006):

"they still haven't come back to us so I understand there are processes because its tied in with the political process at a local level and it gets frustrating I know for [the municipal officials responsible for waste] who like to do this but their hands are tied" [Respondent C, 23/10/2006].

While the responsibility for decision-making about waste is often elevated to council and the municipal manager, accountability for action remains with the subordinate waste officials and line managers. A manager for municipal solid waste expressed his frustration by stating:

"I know that its not because of me, its because of the internal bureaucracy that does not allow me to implement that, so maybe certain instances where I say I need a person to do one, two, three - that person could not be appointed. But when you audit me, you audit me as if I failed to do my work, not knowing why I couldn't implement the Act" [Respondent P, 23/10/2006].

Similarly, the ability to procure services has been removed from line staff, making it difficult for them to implement the necessary changes in waste management through appointment of contractors, or purchase of equipment:

"I can tell you, procurement is a nightmare, it's a nightmare. In the past I could obtain quotations from the best people to do the job. Now we can't even ask for quotations. People from the first floor, clerks gonna get the quotations. They're gonna get the quotations, they're gonna award it, you're not gonna have any say in it" [Respondent O, 23/10/2006].

While little direct evidence was provided by respondents for resultant changes directly due to data collection, the reasons and influences for no or limited change were perhaps more insightful into understanding the research question, and in particular the constraining factors external to the individual.

3.6. Conclusions

Previous research has shown that the need for waste data in South Africa reflects “*greater, currently unfulfilled needs in the sustainable management of waste in South Africa. These needs, which, if fulfilled through reliable, accurate waste information [have] the potential to lead to the improved management of waste in South Africa*” (Godfrey, 2008:1667). This conclusion formed the basis for the research question explored in this paper: ‘Can the collection of data for a national waste information system, change the way waste is managed in South Africa, such that there is a noticeable improvement?’ The research question was explored in this paper through a preliminary theoretical framework of learning (Miller & Morris, 1999).

The research addressed three sub-questions which formed the basis for defining the initial themes used to analyse and interpret the interview transcript data: Do organizations have the ability to collect data on solid waste? Do employees have the ability to assimilate and interpret the data and through a learning process build new knowledge? Do employees (and organizations) have the ability to convert this knowledge into impact (potential to implement change in managing waste)? Applying a qualitative, interpretative approach provided an opportunity to identify further subthemes which emerged from the interview data (**Figure 3-2**).

In terms of theme 1, the ability to collect waste data, the interviews highlight differences in an organization’s ability to collect data, with private waste companies having successfully implemented waste data collection systems. It is evident that there are external factors, or drivers, which have resulted in these organizations already implementing data collection systems well before the piloting of the SAWIS. The main drivers were found to be financial sustainability such as revenue recovery (billing) and reduced operational costs; and environmental reporting obligations such as ISO14000, particularly where the company had an international parent company. However, participants also highlighted the current constraints to data collection, typically within public waste facilities, specifically focusing on the lack of equipment, particularly IT and lack of capacity to collect and interpret the data. These constraints are not however unique to waste data collection and utilization, but constrain municipalities in terms of broader waste service delivery issues (Godfrey & Oelofse, 2008).

The data showed that in terms of theme 2, ability to assimilate and interpret data and through a learning process build new knowledge, certain persons interviewed have assimilated and interpreted the waste data collected for SAWIS, which has raised their awareness around vehicle management; facility planning, costing of operations, and ongoing site operation and maintenance. The result is that certain persons and organizations have been able to use the data and convert the subsequent knowledge to impact (potential to implement change in managing waste) leading to changed practices within the organization. Similarly, there are organizations that do not use the data after having collected it, and therefore do not see the usefulness in having the data available to them, or have a poor understanding of the potential use of this data, resulting in no or little noticeable impact on operations.

It was also found that in terms of theme 3, ability to convert this knowledge to impact, little evidence was found for resultant change in waste practices as a result of data collection during the piloting of the SAWIS. While the desire may exist within individuals to implement change based on this new knowledge and raised awareness around waste management practices, the point of knowledge generation may be removed from the point of decision-making within organizations due to a break in communication, or may be constrained by organizational bureaucracy and administrative procedures. These external factors have made it difficult for persons, particularly within municipalities to both collect waste data, or from the raised awareness associated with the interpretation and internalization of data, to implement the necessary changes within their organization. These external factors hinged largely around governance.

While the preliminary theoretical framework of learning provided a means for interpreting the interview findings, the results showed that knowledge is a necessary but insufficient condition for resultant action. The conceptual framework of learning was shown to be simplistic for understanding the role of waste data in a developing country context such as South Africa, and did not account for external influences. It is proposed that further research is necessary to establish a more conceptually inclusive framework, which explains the complex nature of learning, behaviour and potential for action and impact from environmental information, and specifically waste information, within the South African context.

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CHAPTER 4: THE INFLUENCE OF DATA ON KNOWLEDGE

“PART 1: THE ROLE OF WASTE DATA IN BUILDING KNOWLEDGE: THE SOUTH AFRICAN WASTE INFORMATION SYSTEM”

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4.1. Abstract

An empirical study was undertaken with 31 organisations submitting data to the South African Waste Information System (SAWIS) in order to explore the relationship between data and resultant waste knowledge. The results show that of the three constructs of knowledge (experience, data/information, and theory), experience has the greatest influence on building waste knowledge, nearly twice that of data/information and three times that of theory. Together the three constructs account for 54.1% of the variance in knowledge. Respondents from municipalities and private waste organisations reflect two distinct sub-groups in the data set. While the theoretical model remains the same for the two sub-groups, the way in which knowledge is constructed, and the variance in knowledge explained by the model, differs for the two. A mixed methods research design, combining quantitative statistical analysis and rich qualitative data, contributes to a comprehensive interpretation of the role of waste data in building knowledge in South Africa. While waste data has a minor influence on building knowledge, respondents acknowledge that waste data does have a positive impact on the way their organisations manage waste. However, it is not the data, but rather the resultant waste knowledge and raised level of awareness that causes the operational response. Experience is obtained predominantly through learning from others. Respondents in municipalities, emphasised learning from consultants, landfill site contractors, and colleagues in city-twinning programmes, while respondents in private waste companies, emphasised learning from experienced, senior colleagues.

Keywords: waste knowledge, waste information system, waste data, process of learning

4.2. Introduction

The South African Department of Environmental Affairs (DEA), formerly the Department of Environmental Affairs and Tourism (DEAT), developed and implemented the South African Waste Information System (SAWIS) in 2006. The system, which requires reporting by waste operators on the monthly tonnages of general and hazardous waste landfilled, treated and reprocessed, was designed to “*support the improvement of integrated waste management in South Africa through the dissemination and use of reliable waste information, thereby ensuring the protection of the environment and human health*” (DEAT, 2005:1). Reporting to SAWIS has remained voluntary since its rollout in 2006. Waste activities reporting to SAWIS have increased from 25 to 46 between 2006 and 2011. Draft regulations are currently being developed by DEA to enforce reporting to the system. While the SAWIS may have been intended simply as a means to collect and report waste data for the country, this research explores whether the collection of waste data creates opportunities for learning, raised awareness and resultant behavioural change. The South African government has set a path to building a knowledge-based economy by 2018 recognising the value of knowledge workers in creating a globally competitive economy and sustaining economic growth (Scardamalia & Bereiter, 2003; DST, 2007; Illeris, 2009). In addition, waste management in South Africa is becoming more technologically demanding, the business more competitive and with increasing costs and legislative requirements, profit margins smaller. Knowledgeable persons within the waste sector are therefore crucial to the improvement of waste management in the country.

Godfrey & Scott (2011) showed in the 2006 empirical study that some respondents from the South African waste sector had assimilated and interpreted the waste data collected for SAWIS, which had through a learning process built new knowledge. This raised respondents’ awareness of issues such as vehicle management, facility planning, costing of operations, and ongoing site operation and maintenance. However, there were persons who did not use the data after having collected it, and therefore did not see the usefulness in having the data available to them, or had a poor understanding of the potential use of the data, resulting in no or little noticeable impact on operations. The 2006 study used Miller and Morris’ (1999) process of learning (**Figure 4-1**) as a theoretical framework to assess, by means of qualitative methods, the influence of waste data and information in building knowledge. Godfrey & Scott (2011) showed that this preliminary theoretical framework of learning was inadequate for understanding the role of waste data in a developing country context such as South Africa, in that it did not account for the influence of external societal forces. The authors proposed that further research be undertaken, by applying a more conceptually inclusive framework that accounts for the complex nature of learning, behaviour, and potential for action from waste data collection, within the

broader societal context of South African as a developing country in the process of transformation.

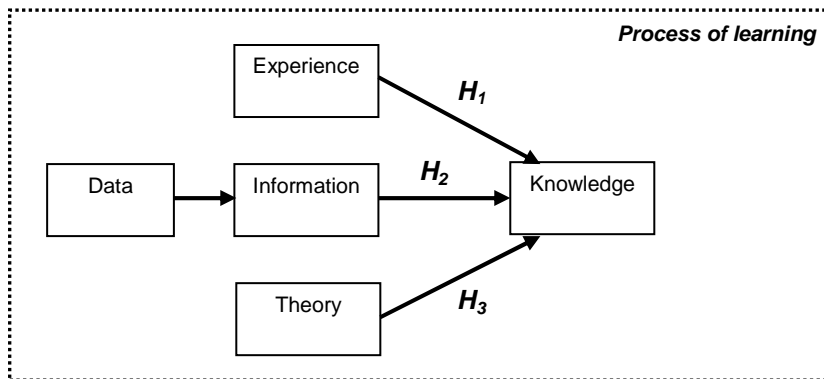


Figure 4-1. Theoretical framework of learning (Miller and Morris, 1999)

This paper builds upon the research of Godfrey & Scott (2011) by extending the theoretical framework to allow the authors to more adequately explain the influence of data on behaviour. The study, undertaken in 2011, is therefore the second empirical study by the lead author to explore the influence of waste data in changing the way waste is managed. Given the wealth of information in the findings of this study, the results are presented in two papers. In this first paper, the authors re-examine the relationship between data, theory, and experience in building waste knowledge in 2011, using both quantitative and qualitative research methods. Quantitative methods were not possible in the 2006 empirical study given the small population size. The aim of this paper is to understand the role of three constructs (data, theory and experience), and specifically waste data, in the creation of waste knowledge. The paper also reflects on whether changes in waste data use have occurred in the South African context between 2006 and 2011. The second paper (Godfrey *et al.*, forthcoming) builds on the process of learning, to examine the influence of data and knowledge on waste behaviour.

4.3. Theoretical framework

4.3.1. Learning

There are many learning theories and paradigms applied mostly in the fields of education and educational psychology (Illeris, 2009). While learning is traditionally considered to be the acquisition of knowledge and skills, more recent approaches to learning consider aspects such as emotional, social and societal dimensions, with the result that there is no generally accepted definition of the concept (Illeris, 2009). Miller & Morris' process of learning, taken from the field of knowledge management, specifically identifies data as a construct of knowledge

building. This conceptualisation is particularly relevant to the research question explored here and hence its adoption as a theoretical framework.

The process of learning put forward by Miller and Morris (1999) proposes that data, theory, and experience each contribute to the creation of knowledge (**Figure 4-1**). It shows how collected data is converted to information and together with the application of existing theory (which puts that information into the correct context) and experience of real world applications, builds knowledge (Allee, 1997; Miller & Morris, 1999; Poch *et al.*, 2004). Knowledge, which is considered by Allee (2003:264) to be “*the capacity to act*”, is seen as an important component of attitude formation and of behaviour. According to Miller & Morris (1999) without any one of the three constructs, learning does not take place and knowledge is not created. Their process of learning is constructivist in nature, where the individual actively builds and constructs their knowledge. Learning, on the other hand, is considered to be a process of “*gaining knowledge, comprehension or mastery*”, “*acquiring or creating knowledge*” (Allee, 1997:50) or as a relatively permanent change in behaviour or behaviour potential (Bandura, 1977; Baron, 1995). Scardamalia and Bereiter (2003) see learning as an internal, almost unobservable process resulting in changes in beliefs, attitudes, or skills.

4.3.2. Hypotheses

The intention of the research is to explore the question “*Can the collection of data for a national waste information system change the way waste is managed in South Africa, such that there is a noticeable improvement?*” While the relationship between data and behaviour is explored by Godfrey *et al.* (forthcoming), this paper focuses on a specific sub-question of this research, namely whether the collection of data for the SAWIS can build waste knowledge.

This sub-question is explored by examining the way in which experience, data/information, and theory influence the creation of knowledge through the following three hypotheses (**Figure 4-1**):

- H₁**. Personal waste experience has a positive effect on building waste knowledge
- H₂**. Waste data (and information) have a positive effect on building waste knowledge
- H₃**. Waste theory has a positive effect on building waste knowledge

Since participating organisations assimilate their waste data into waste information before submitting it to the SAWIS, data and information are treated as a single construct for the purposes of this research.

4.4. Method

4.4.1. Participants

In order to fully investigate the research question, participating organisations must have recently submitted data to the SAWIS. There are two main types of organisation that report data to SAWIS, namely public organisations (municipalities), and private organisations (itself of two types: industrial and private waste companies). The population of possible participants in the research was therefore limited to those organisations that had submitted data to the SAWIS in 2009 and 2010 (**Table 4-1**). Only 32 organisations reported to SAWIS in both 2009 and 2010, two organisations in 2009 only, and six organisations in 2010 only, giving 40 unique organisations (14 municipal, 26 private). Because of the small population size (n=40), sampling was felt to be unnecessary and all organisations were approached to participate in the research.

Table 4-1. Number of organisations reporting data to SAWIS in 2009 and 2010

Reporting year	Reporting organisations ^{*)} (n=)
2009	34
2010	38

Table 4-2. Number of waste activities reporting data to SAWIS in 2009 and 2010

Activity type	Activities (n=)	
	2009	2010
Landfills	28	29
Treatment Facilities	8	9
Reprocessors	7	8
Total	43	46

^{*)} 39 activities reported to SAWIS in both 2009 and 2010, four activities for 2009 only and seven activities in 2010 only, giving 50 unique activities.

Certain organisations are submitting data for more than one waste activity (**Table 4-2**). Waste activities are identified in SAWIS as individual landfill sites, treatment facilities or reprocessors. Waste generators and transporters are presently not required to submit data to SAWIS at present (DEAT, 2005). The number of reporting activities represents only a small fraction of operating waste facilities in the country. According to the landfill census conducted as part of the transfer of the waste permitting function from the Department of Water Affairs (DWA) to DEAT, there were a total of 226 operating medium and large general and hazardous waste landfills as at 2005/06 (DEAT, 2006). The number of landfills currently reporting data to SAWIS therefore represent an estimated 12-13% of currently operating landfills that would be required to submit data (DEAT, 2005). However, since reporting to SAWIS is still voluntary,

such low figures can be expected (DEAT, 2004). Voluntary waste data reporting programmes in Mexico showed only 5% of industries provided information (CEC, 2004; Nauman, 2004) whereas in Israel, 40-60% of local authorities voluntarily reported waste data (Sheshinksi, 2002). Even though still voluntary in South Africa, reporting to SAWIS has increased from 25 to 46 waste activities between 2006 and 2011. With no national data on the total number of operating treatment facilities or waste reprocessors, it is not possible to comment on the percentage of these activities reporting, however it is also considered to be low.

Respondents were identified within each of the participating organisations as the registered system user or person responsible for capturing and submitting the waste data to SAWIS. Of the 40 participating organisations, two were no longer contactable and seven organisations did not make themselves available to participate in the study. In certain organisations, the responsibility for capturing and uploading the data has been split between different persons. In these cases, both persons were approached for interviews. From the 31 available organisations, 44 respondents participated in the study (15 municipal, 29 private).

4.4.2. Procedure

Given the small population size and the resultant limitations on the methods of quantitative analysis that can be used, the research adopted a hybrid or mixed-method design, combining both quantitative and qualitative research methods (Leedy & Ormrod, 2005; Moser & Felton, 2010). In so doing, the authors aim to explore the relationships between the theoretical constructs by means of quantitative data (and associated statistical analysis), while at the same time seeking a deeper understanding in these relationships through the rich qualitative data. In this way, a fuller understanding is obtained as to the role of data in building waste knowledge in South Africa.

Data were collected by means of semi-structured interviews, each lasting approximately one hour, during which a questionnaire was administered (**Annexure 2**). The questionnaire consisted of two parts, Part I being a questionnaire of 57 closed questions to elicit quantitative data, and Part II being an interview schedule of 11 open questions, administered by the lead researcher, to guide the discussion and elicit qualitative data. Of the 57 closed and 11 open questions, 24 closed and three open questions relate specifically to this research paper, i.e. those questions related to the constructs of knowledge.

4.4.3. Quantitative data collection

Each of the three constructs (data/information, theory, experience) were measured by means of a seven point semantic differential scale, ranging from 1 to 7 (strongly disagree/strongly agree). Questions assessing the same construct were interspersed with those of other constructs to ensure a non-systematic order to the questions, thereby reducing the chance for response bias on sets of questions (Ajzen, 2006). Self-reported waste knowledge was measured on a scale of 1 = “poor” to 7 = “excellent”.

Following the recommendations of Tenenhaus *et al.* (2005), Henseler *et al.* (2009), and Vinzi *et al.* (2010), the reliability of each set of questions (i.e. instrument) was assessed using Dillon and Goldstein's rho (ρ); dimensionality was assessed using the size of the first eigenvalue relative to the second. Dillon and Goldstein's rho is a composite measure of internal consistency reliability that is well-suited to the partial least squares path modelling method of analysis used here. For exploratory work, ρ should be equal to or greater than 0.7 (Vinzi *et al.*, 2010). Instruments are considered to be unidimensional if the first eigenvalue is greater than one, and the second eigenvalue less than one; or if the first eigenvalue is much greater than the second. Although it is no longer considered to be a good measure of reliability (Sijtsma, 2009), the authors also report Cronbach's alpha (α), since it is still widely used.

4.4.3.1. Data/Information

Two items were used to measure the role of data in the creation of respondents' waste knowledge. These are: “*I have built my waste knowledge mostly through collecting and analysing waste data*”, and “*Collecting waste data has been an important way of learning about waste management for me*”. The instrument is unidimensional and internal consistency reliability (ρ) is good to very good (**Table 4-3**).

4.4.3.2. Theory

Two items were used to measure the role of theory in the creation of respondents' waste knowledge. These are: “*I have built my waste knowledge mostly through courses/training/degrees*”, and “*Studying and attending courses has been an important way of learning about waste management for me*”. The instrument is unidimensional and internal consistency reliability (ρ) is excellent (**Table 4-3**).

4.4.3.3. Experience

Two items were used to measure the role of personal experience in the creation of respondents'

waste knowledge. These are: “*I have built my waste knowledge mostly through practical experience on waste projects*”, and “*Working on real waste projects has been an important way of learning about waste management for me*”. The instrument is unidimensional and internal consistency reliability (ρ) is adequate to good (**Table 4-3**).

Table 4-3. Summary statistics and quality indices for the Partial Least Squares Path Model

LV (ξ)	Summary of Inner Model			Reliability / Dimensionality			
	LV-type	MVs	Av.C	α	ρ	Eig.1st	Eig.2nd
Data/information	Exogen.R	2	0.8428	0.816	0.916	1.689	0.311
Theory	Exogen.R	2	0.8736	0.862	0.935	1.757	0.243
Experience	Exogen.R	2	0.6704	0.530	0.810	1.360	0.640

Abbreviations: LV = latent variable/construct; MV = measurement variable; MVs give the number of MVs (items/indicators/measurement-variables) in the construct/LV; Av.C is the average communality (communality index) and is the same as the average variance extracted (AVE, not shown separately); α is Cronbach’s alpha (standardized); ρ is Dillon-Goldstein’s (or Jöreskog’s) rho (aka composite reliability); Eig.1st/Eig.2nd are the first and second eigenvalues from a principal component analysis of the standardized manifest variables (*i.e.* items/indicators of the construct).

4.4.4. Qualitative data collection

In addition to the closed questions, the following open questions were posed to stimulate discussion: “*Was your organisation collecting waste data before it was required for SAWIS, and if yes, for what reason were you collecting data?*”, “*What do you feel have been the three most significant activities/events/ experiences in your career that have contributed to your current waste knowledge?*”, and “*What have you personally learnt about waste management in your organisation from the waste data that you are collecting for SAWIS?*” These questions provided insight into the socially constructed meaning of data in building waste knowledge in public and private waste organisations in South Africa.

4.4.5. Data analysis and interpretation

Due to the small population size (participating organisations) from which samples were drawn, partial least squares path modelling (PLSPM) was used to analyse the data. Traditional structural equation modelling (SEM) is a large-sample method, requiring hundreds, or even thousands, of samples (Henseler *et al.*, 2009). Traditional SEM also makes strong distributional assumptions. The PLSPM method, in contrast, makes few assumptions and is suitable for use with small to very small data sets (Henseler *et al.*, 2009). Partial least squares path modelling is component-based whereas SEM is covariance-based; nevertheless, the results of the two methods are often similar (Tenenhaus, 2008; Vinzi *et al.*, 2010). The latent variables were estimated using a measurement model as described in Section 4.4.3. All measurement instruments were unidimensional, had high reliability, and needed no further modification. The

theoretical or structural model, as described in Section 4.3. **(Figure 4-1)** was fitted using the latent variables estimated by the measurement model. The results are presented in terms of the path diagram as shown in **Figure 4-2**. The path diagram consists of a set of regression (or path) coefficients (β) showing the influence of the input variables on the target variable (*knowledge*), and the coefficients of determination (R^2), which gives an indication of the amount of variance of the target variable that the model explains.

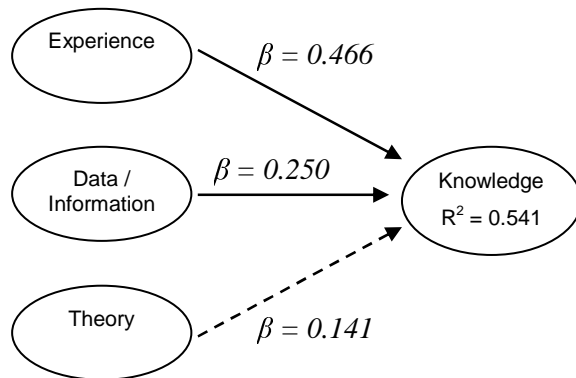


Figure 4-2. Path diagram for the global model

Having adopted a mixed research method, data analysis also included an interpretation of the qualitative data. A large body of interview transcript data was sorted and categorized into a small set of pertinent themes (Leedy and Ormond, 2005). In the thematic analysis, two techniques were chosen for interpretation of the research data; pattern matching and explanation building (Yin, 2003). Content analysis (Whitley, 2002) was also applied to interpreting the qualitative data. This allowed the authors to delve into the meaning, perceptions, and beliefs of respondents regarding the construction of knowledge. Interpreting the qualitative data provided deeper insights into the research question and served to corroborate the findings of the statistical analysis. Due to the adopted mixed methods research approach, results are presented as statistics, narrative, and category (thematic) trees.

During the interviews, and in the analysis of the qualitative data, there were signs of significant differences in responses by respondents from the two types of organisations, i.e. public and private. To test this, a segmentation tree analysis (Sanchez, 2009) was carried out. Type of organisation (whether municipal or private) was found to provide the basis for a significant split in the data set ($p = 0.0008$), indicating the presence of two local models. The structural model is the same in the two models, but there were found to be significant differences between one or more of the path or regression coefficients in each part of the data, based on a modified F-test (Sanchez, 2009). This means that there are significantly different forces at work in public and

private waste organisations. This distinction between organisational types is shown to be significant in the analysis of the data.

4.5. Results

4.5.1. Statistical analysis of quantitative data

4.5.1.1. Global model

The structural model for the whole data set shows that of the three antecedents to knowledge, experience ($\beta = 0.466$) has the greatest influence on building waste knowledge, with minor influences from information ($\beta = 0.250$) and theory ($\beta = 0.141$). Together the three variables account for 54.1% of the variance in knowledge ($R^2=0.541$) (**Figure 4-2**).

The analysis of the qualitative data corroborates the statistics presented in **Figure 4-2** and thus provides some confidence in these results, despite the small population size. These findings are discussed in further detail in the following sections.

4.5.1.2. Local models

Segmentation-tree analysis reveals that there are in fact two sub-groups in the data set, namely a *Municipal* local model and a *Private* local model (**Figure 4-3**). These sub-groups are subject to different influences, impulses and behaviours. Given the small population size and even smaller sub-population size, validation of these results should be undertaken in future research when the number of respondents submitting data to SAWIS has significantly increased.

The *Municipal* local model shows that theory ($\beta = 0.483$) and information ($\beta = 0.429$) have the greatest influence on building waste knowledge, with little influence from experience ($\beta = 0.144$) (**Figure 4-3**). This is contrary to what we see in the global model (**Figure 4-2**). Together the three constructs account for 49.5% of the variance in knowledge of municipal respondents ($R^2=0.495$). The *Private* local model shows that experience ($\beta = 0.696$) has the greatest influence on building waste knowledge, with little influence from information ($\beta = 0.115$) and theory ($\beta = 0.202$). This is in agreement with the global model (**Figure 4-2**), highlighting the impact of the dominant local model on the global model. Together the three constructs account for 77.9% of the variance in knowledge of private respondents.

Of the three hypotheses, H_1 is supported in the *Private* local model, while H_2 and H_3 are supported in the *Municipal* local model. For the global model, H_1 is supported, with experience shown to have the greatest influence on building waste knowledge, nearly twice that of

data/information. The fact that there appear to be differences in the way in which knowledge is created between public and private organisations is consistent with Illeris' (2009) model of learning. Illeris (2009) combines traditional behaviourist and cognitive learning theories with modern social learning theories by recognising both internal and external conditions. As a largely traditional learning theory, Miller & Morris' (1999) process of learning does not account for external conditions in the learning process, but focuses on what Illeris (2009:9) calls "the psychological acquisition process".

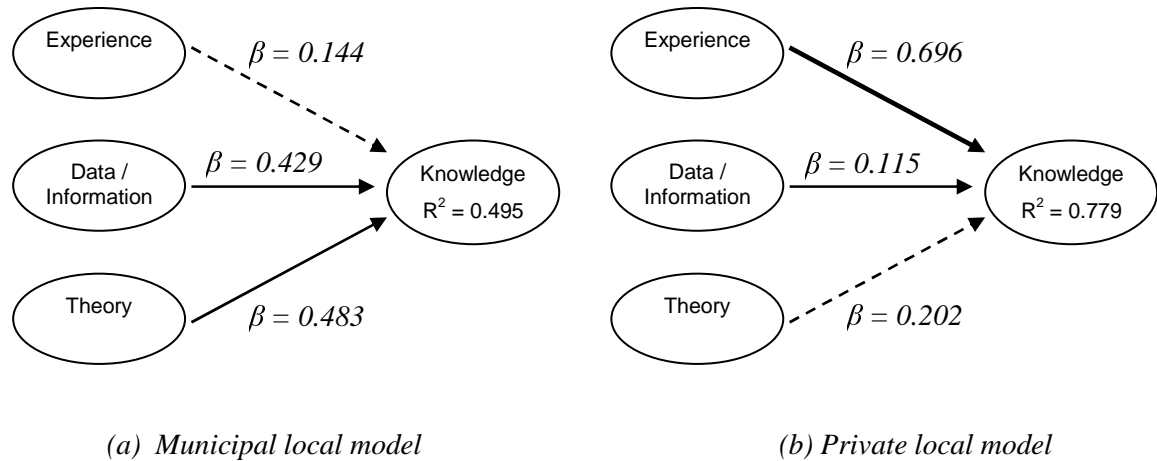


Figure 4-3. Path diagrams for the local models (municipal and private)

4.5.1.3. Self reported waste knowledge

Current levels of self-reported technical waste knowledge differ slightly for municipal ($\bar{x} = 5.60$, $SD = 0.99$) and private sector respondents ($\bar{x} = 5.21$, $SD = 1.35$), with municipal respondents reporting on average a higher level of technical waste knowledge than private sector respondents. No significant correlation (at the 10% level of significance) was found between self-reported waste knowledge and respondent age for municipal respondents ($r = 0.34$) or private respondents ($r = 0.07$). A weak correlation (at the 10% level of significance) was found between self-reported waste knowledge and years of waste experience, both for municipal respondents ($r = 0.54$) and for private sector respondents ($r = 0.43$), as might be expected. High scores (5-7) of self-reported waste knowledge are particularly evident in respondents aged 20-39 years and with less than 5 years experience, suggesting that self-reported knowledge is not an accurate reflection of actual levels of waste knowledge. Self-reports are known to be subject to social desirability response bias (Whitley, 2002). In addition, self-reported waste knowledge is a very subjective response. An inexperienced, young respondent could report a very high level of waste knowledge relative to an experienced waste professional, simply because they are not aware of the full extent of possible knowledge.

4.5.2. Qualitative analysis of knowledge building

Analysis of the open question: “*What do you feel have been the three most significant activities/events/experiences in your career that have contributed to your current waste knowledge*”, shows that there is a strong tendency towards experience as the main means of learning. Content analysis of this question shows that 67.7% of first responses favour experience, 25.8% theory and 6.5% data/information. These results are consistent with the results of the partial least squares path analysis (**Figure 4-2**) which shows that, of the three constructs, experience has the greatest influence ($\beta = 0.466$) on building waste knowledge in South Africa. Both the quantitative and qualitative data show that theory and data/information are not as significant as experience in building waste knowledge. However, their order of significance differs between the two methods of analysis, with the statistical results showing a greater influence of data/information than of theory.

The content analysis revealed that while experience remains the dominant means of learning for both private sector (73.7% of first responses) and municipal (58.3%) respondents, theory has a greater influence for municipal respondents (33.3%) than for private sector respondents (21.1%). Data/information plays a minor role for both municipal and private respondents at 8.3% and 5.3% respectively. This differs from the evidence provided by the local models (**Figure 4-3**), where, for municipal respondents, the statistical results suggest a greater influence from data/information and theory, on knowledge construction, than from experience.

Through the interpretation of the qualitative data, the following sections provide insight into the socially constructed meaning of the three constructs (data, theory and experience), in relation to the creation of waste knowledge.

4.5.2.1. Data

In analysing the open question: “*What have you personally learnt from the waste data*”, 42.1% of respondents feel that they have not learnt from the data. The remaining respondents, while acknowledging that they have learnt from the data, find it difficult to put this learning into words. At best, respondents acknowledge a better sense of ‘knowing’ about the waste they receive (Respondent 5, 7, 13, 19, 23, 36), or have developed insights into the data through regular analysis, which allows them to detect discrepancies in the data (Respondent 2, 6, 15). While respondents do not have a clear sense of what they have learnt from the data, there is a sense that collecting data has had a positive impact on the way their organisation manages its waste. This may be because learning from data is subtle and often difficult to distinguish from other influences, with the result that it may not be obvious to someone that they have been

through a learning process (Denisov & Christoffersen, 2001; Jones, 2001; Zito & Schout, 2009). This is what Scardamalia & Bereiter (2003) refer to as an internal, almost unobservable process. While respondents feel that collecting waste data has a positive impact on the way their organisations manage their waste, they do not feel that the data per se has been the cause of the operational responses in the organisation. It therefore appears to be knowledge, and not data, that is directly responsible for causing operational responses in organisations. This is discussed further in Godfrey et al., (forthcoming).

4.5.2.2. *Theory*

As with data, respondents did not see theory as being a major contributor to building their waste knowledge:

“I think it’s very important to have a certain theoretical knowledge. It’s very important to have that, but I think you only really start learning once you’re working at a [landfill] site. Being on site, practically seeing what happens when you implement certain things, you can’t get away from that practical knowledge as well” (Respondent 22).

This response is understandable, given that there are no specific waste management degrees or diplomas offered in South Africa. Waste is typically included as a module in environmental management or engineering degrees: *“You don’t really learn waste from university. You learn pure chemistry and reactions. Now with the waste, it’s unexpected reactions sometimes”* (Respondent 23). However, there has been an increase in waste management seminars, conferences, and training courses offered by private and public institutions, which do help in building the knowledge of those in the waste sector.

4.5.2.3. *Experience*

“I’ve been in the waste industry for the last 20 years. So I’ve built up a lot of knowledge through the years, experience” (Respondent 36).

A content analysis of all experiential learning responses, reveals two main categories (i) direct learning through ‘self’, e.g. day-to-day activities and practical waste projects; and (ii) learning from the experience of others, while on the job, e.g. site contractors, experienced colleagues. There is a very close split between these two categories, with 51.0% of responses favouring gaining experience through learning from others on the job and 49.0% of responses favouring gaining experience through self-learning. This highlights the importance of having access to experienced colleagues and service providers (contractors, consultants) in building waste knowledge in South Africa.

The opportunities to learn from the experience of others, include (i) mentoring by skilled, experienced senior colleagues (often with more than 15 or 20 years practical waste experience), evident in private waste companies (Respondent 5, 11, 22, 37) and municipalities (Respondent 2, 14, 15, 26); (ii) working with contractors operating municipal and private industry landfill sites (Respondent 13, 31); (iii) engaging with consultants contracted by the municipality (Respondent 28) or on retainer to the private company (Respondent 29); (iv) access to equipment suppliers who train local staff and send technical updates (Respondent 30); and finally (v) the establishment of country-to-country city twinning programmes where local municipal officials have access to skilled international waste professionals (Respondent 18, 28).

The importance of learning from experienced senior colleagues is evident if these statements by municipal and private respondents: *‘I was trained and educated by an individual with 25 years of landfilling experience. That was a huge advantage’* (Respondent 26). *“The technical supervisor [on-site] was an environmental engineer. She was quite knowledgeable with waste. So I had someone to guide me”* (Respondent 37).

However, access to experienced colleagues within municipalities is becoming an issue. First, there is a sense amongst older waste officials, who have been with the municipality (often for more than 15, 20 years) that young staff, often in more senior positions in the waste department, are not interested in drawing on their knowledge:

“I’m 30 years in municipal services and for the past 25 years I’ve been in waste. I’ve been in charge of waste. It’s difficult, because [new managers] won’t take note of what you say, because they’ve got their own agendas. You see things are going wrong, you waste your time to say listen look at that. They said no, you’re interfering. They don’t want to take advice from a white man, even technically, because then they feel that they’re incompetent” (Respondent 6).

Second, experienced waste officials in municipalities are being head-hunted by private waste companies who see the value of their experience (Respondent 15) and who also recognise the potential business opportunities created by removing experienced personnel from the municipality (Respondent 18):

“If they can head hunt all the top guys or the experience in the municipality, they can hire it back at a cost to the municipality. So, of course it makes very good business sense, in that you’re creating a gap which they then can take. I mean if you take everything away from the municipality they have to you use you, there’s no other choice” (Respondent 18).

Neither of these issues would be problematic if municipalities were developing new experienced

waste officials that reflect the demography of the country. However, this does not seem to be the case from those respondents interviewed as shown in the results below. First, with 57.1% of black municipal respondents having been in their current job for less than 2 years and 71.4% less than 4 years (**Table 4-4**), the data reflect a very mobile young, black workforce in the waste sector.

Table 4-4. Years spent in current job (public and private sector) according to race

		Years in current job			
		<2	2-4	4-8	>8
Municipal	Black	57.1%	14.3%	14.3%	14.3%
	White	0.0%	14.3%	42.9%	42.9%
Private	Black	66.7%	22.2%	11.1%	0.0%
	White	45.0%	10.0%	25.0%	20.0%

Note: Presenting the results according to race is necessary to highlight the social inequalities in the societal context in which waste information is being analysed.

Second, there is a sense that young professionals are not interested in making a career in waste management, and certainly not in the municipal waste sector:

“I want somebody young to come in so I can train him. I’ve got 12 years left, so what is going to happen after 12 years, who is going to take it over? There’s nobody, it seems like the youngsters that come in, they just want to gain that experience for a year or two and jump to the next path in their career. That’s all, they don’t want to do it as a fixed [job]. They’re really not into waste themselves, it seems like it’s something they don’t want to do” (Respondent 15).

4.5.3. Responding to the current levels of waste knowledge

Illeris (2009) points out that education and skills, both at the individual and company level, are very valuable in today’s global economy and knowledge society. It is evident that the private waste sector recognises the importance of knowledge in giving them an advantage over their competitors. This is evident from the extent to which senior, experienced municipal waste officials are head-hunted by the private sector and in the measures that have been put in place within waste companies, as highlighted below.

From the results, there are indications that the South African waste sector has moved towards a type of social learning. This is consistent with widely supported modern social learning theories, which posit that people learn from each other through observation, imitation and sharing of knowledge (Scardamalia & Bereiter, 2003). Illeris (2009) recognised that learning is subject to an interaction between the person and their external social and cultural environment.

In the near absence of (or access to) formal waste training programmes in South Africa, i.e. theory, some respondents have found innovative ways of social learning. Respondents in municipalities report that they have sought out mentors, where they do not formally exist within the municipality, in the form of knowledgeable consultants or site contractors. Municipalities have, in rare instances, put twinning programmes in place with international cities, where knowledge and best practice is shared and practical implementation projects showcased to municipal officials and councillors. Private companies have put technical managers, or mentors in place, whose responsibility it is to regularly share current local and international best practice in their field with colleagues (Respondent 22, 37); or internal organisational environmental conferences, where employees tasked with environmental and waste management can share problems and jointly seek solutions (Respondent 20, 23):

“Since we’re a national company, we get our national meetings where we get [together] with other people in the same level and we share experiences. Those sessions are very informative and very helpful, because if you were alone and you sit with this kind of situation, it could get too much. But having those sessions where you share and... there’s also lots of resources available for you to get information” (Respondent 23).

With experience being the most significant component of building waste knowledge, respondents reported that the role of mentors is crucial in personal development: *“I think proper mentoring from the supervisor. I’ve been working under my supervisor’s guidance for 8 years. I’ve learnt a lot from him, he’s a specialist in terms of waste”* (Respondent 11). However, there is evidence of differences between public and private respondents regarding their opinions of senior colleagues as mentors. While the respondent from a private waste company recognises the opportunity in senior colleagues: *“I look at the people above me as mentors, people that I try to emulate myself to and use them as examples”* (Respondent 8), one of a few municipal respondents is totally disillusioned by those he needs to report to: *“Our manager he’s been suspended for a month because of corruption”* (Respondent 6).

4.5.4. Data use within organisations

Analysis of respondents’ answers to the question: *“Was your organisation collecting waste data before it was required for SAWIS, and if yes, for what reason were you collecting data?”* shows that a high proportion (84.6%) of the participating organisations were already collecting waste data prior to the introduction of SAWIS. Financial performance and environmental reporting were seen to be the main drivers for data collection in private organisations, two factors essential in private business (Godfrey & Scott, 2011).

In analysing the data, it is evident that there are distinct differences in waste data use between municipalities, private industry, and private waste companies. As such, the responses have been coded and categorised per organisational type (**Figures 4-4 to 4-6**). The results show that organisations use data on waste management in diverse ways that often reflect the waste discourses of the three organisation types (**Figures 4-4 to 4-6**). This is an improvement on the 2006 study where it was shown that public and private respondents had limited understanding of the potential uses of waste data within their organisations (Godfrey & Scott, 2011). The main uses of the waste data reported in 2006 were at a general level and included: vehicle management, facility planning, costing and site operation (Godfrey & Scott, 2011). Respondents in 2011 show a much greater understanding of, and insight into, the uses and benefits of waste data within the organisation, as reflected in the category trees (**Figures 4-4 to 4-6**).

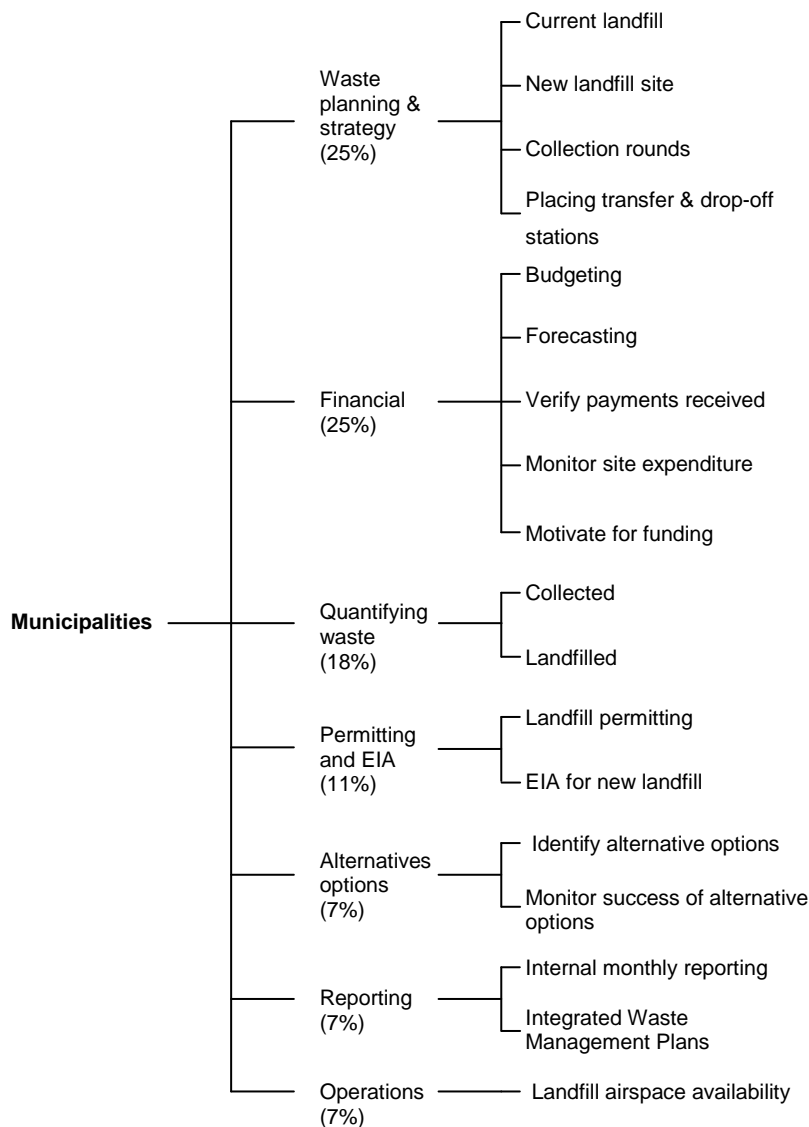


Figure 4-4. Waste data use by municipalities

Municipalities (**Figure 4-4**) use their waste data mainly for planning and strategic purposes (25% of responses) and for financial management (25%). Private industry uses its data for reporting (28%) and for tracking of waste (managing liability) (17%) (**Figure 4-5**); while private waste companies predominantly use their waste data for operational (40%) and financial management (37%) (**Figure 4-6**).

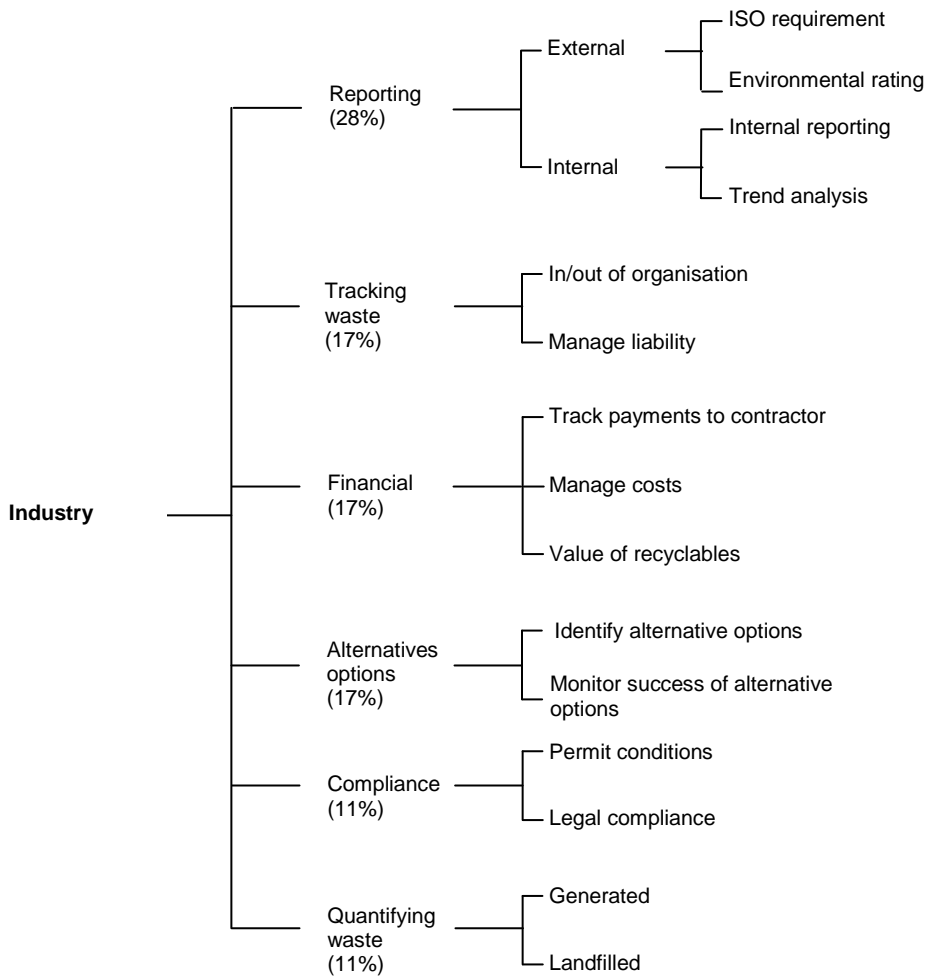


Figure 4-5. Waste data use by private industry

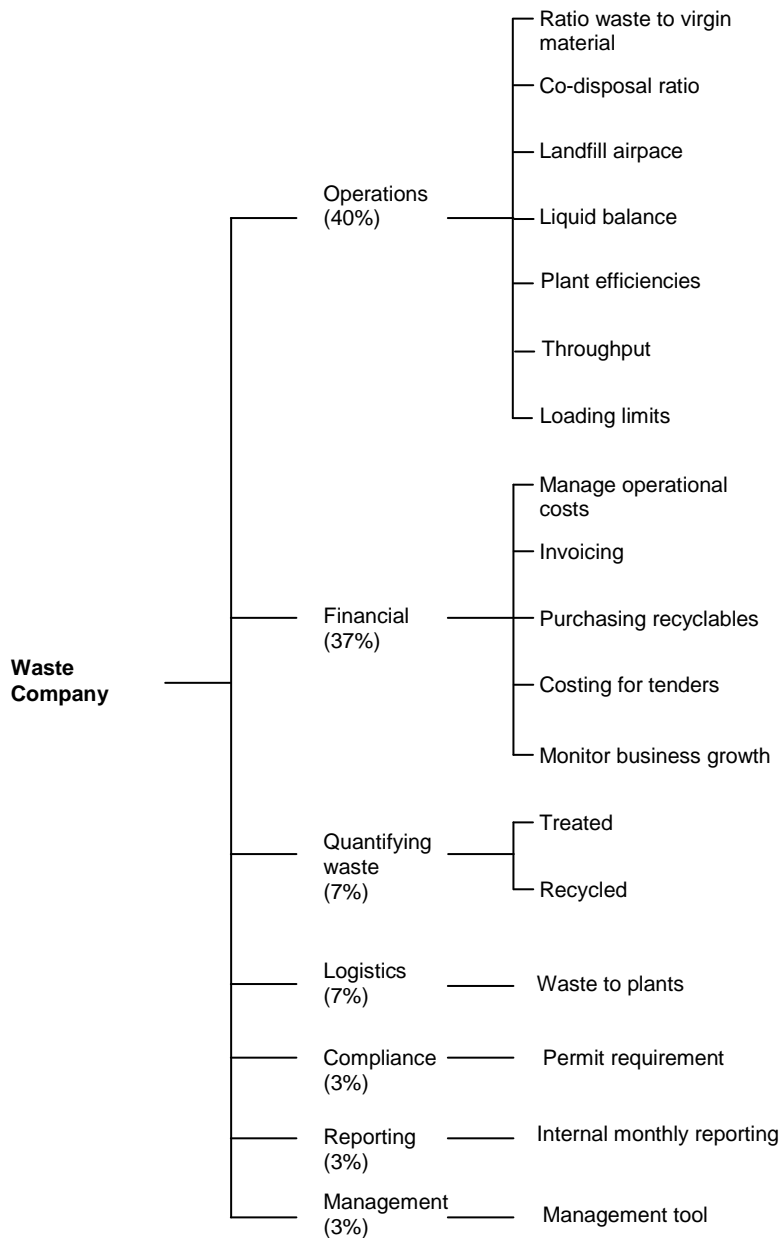


Figure 4-6. Waste data use by private waste companies

4.6. Conclusions

Godfrey & Scott (2011) showed that in terms building new knowledge, certain persons interviewed in 2006 had assimilated and interpreted the waste data collected for SAWIS, and that this had raised their awareness regarding vehicle management; facility planning, costing of operations, and ongoing site operation and maintenance. However, there were organizations that did not use the data after having collected it. Either they did not recognise its value, or they had a poor understanding of its potential usefulness. For these organisations data collection had little or no impact on their waste operations. While the preliminary theoretical framework of

learning provided a means for interpreting the interview findings, the results showed that knowledge is a necessary but insufficient condition for resultant action.

These conclusions formed the basis for the study reported on here, which builds upon the initial preliminary theoretical framework by exploring the relationship between data and resultant waste behaviour. This research is presented in two parts, with this paper focussing on the relationships between the three constructs of knowledge; data, theory, and experience, and waste knowledge. Given the small population size of organisations reporting data to SAWIS, the use of both quantitative and qualitative data, and methods of analysis, have provided a rich picture of the role of waste data in building waste knowledge.

The structural model shows that experience has the greatest influence on building waste knowledge, nearly twice that of information and three times that of theory. Together the three variables (data, theory and experience) account for 54.1% of the variance in knowledge.

Municipal and private waste organisations are shown to represent two distinct sub-groups in the data set, subject to significantly different influences, impulses and behaviours. The local models reflect a statistically significant difference between these two sub-groups. For the *Municipal* local model, the three constructs account for 49.5% of the variance in knowledge. Theory and information are seen to be the dominant means of building knowledge in municipal respondents, three times greater than experience, while experience is still seen to be the dominant means of knowledge building for private respondents. For the *Private* local model, the three constructs account for 77.9% of the variance in knowledge. The *Private* local model is in alignment with the global model, highlighting the impact of a dominant local model on the overall structural model. The large difference in the contribution of the three constructs to building knowledge for the municipal (49.5%) and private (77.9%) sub-groups, measured for the same population at approximately the same time, suggest that there are strong external influences at play in how municipal and private respondents build their knowledge.

The main findings of the statistical analysis are corroborated by the qualitative data. A content analysis of responses to the open question on the means of learning shows that 67.7% of all respondents report experience as the principle means of building waste knowledge, with 25.8% of responses noting theory and 6.5% of responses selecting data as a means of building waste knowledge. While theory and data are shown to have less significance in building knowledge in both the quantitative and qualitative data, their order of significance differs between the methods of analysis, with the qualitative data providing narratives that illustrates a greater influence of theory than data. While experience remains the dominant means of learning for

both private (73.7%) and municipal (58.3%) respondents, theory has a greater influence for municipal respondents (33.3%) than private (21.1%). Data plays a minor role in building knowledge for both municipal (8.3%) and private respondents (5.3%). Given the minor influences of data and theory, combined with the small population size and even smaller sub-population, caution should be applied in the interpretation of the statistical results of the local models. What remains clear though, from both methods of analysis, is the dominant role of experience in building waste knowledge.

While statistically, waste data is shown to have a minor influence on building knowledge, respondents explained that collecting waste data does have a positive impact on the way their organisations manage their waste. However, according to respondents, it is not the waste data that causes the operational response in organisations. This suggests that it is the resultant knowledge, rather than data directly, that influences action.

Out of necessity, the South African waste sector has adopted a form of social learning, where knowledge is socially constructed. In the near absence of (or access to) formal waste training programmes (theory), some respondents have found innovative ways of social learning. Learning from others is shown to be the dominant form of experiential learning, where consultants, site contractors, suppliers and experienced colleagues play a major role in building local waste knowledge.

Category trees, portraying the use of waste data in 2011, show a much greater understanding and insight into the uses and benefits of waste data within the organisations in 2011 than in 2006. As with the building of knowledge, organisational differences are evident in the use of waste data. Municipalities show an emphasis on data use for waste planning and strategy, and financial management. Private industry shows an emphasis on data use for reporting and tracking of waste; while private waste companies predominantly use their waste data for operations and financial management.

Miller & Morris (1999) suggest that without any one of the three constructs, knowledge is not created. While data/information and theory are currently shown from both the quantitative and qualitative data to have minor influences in building waste knowledge in public and private institutions, waste knowledge is being created. What the results cannot show is the quality of this knowledge. This is something that must be explored in future, to gauge whether differences in quality and depth of knowledge occur between organisation types in South Africa.

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CHAPTER 5: THE INFLUENCE OF DATA ON BEHAVIOUR

“PART II: THE EFFECT OF DATA ON WASTE BEHAVIOUR: THE SOUTH AFRICAN WASTE INFORMATION SYSTEM”

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5.1. Abstract

Combining the process of learning and the theory of planned behaviour into a new theoretical framework provides an opportunity to explore the impact of data on waste behaviour, and consequently on waste management, in South Africa. Fitting the data to the theoretical framework shows that there are only three constructs which have a significant effect on behaviour, *viz* experience, knowledge, and perceived behavioural control (PBC). Knowledge has a significant influence on all three of the antecedents to behavioural intention (attitude, subjective norm and PBC). However, it is PBC, and not intention, that has the greatest influence on waste behaviour. While respondents may have an intention to act, this intention does not always manifest as actual waste behaviour, suggesting limited volitional control. The theoretical framework accounts for 53.7% of the variance in behaviour, suggesting significant external influences on behaviour not accounted for in the framework. While the theoretical model remains the same, respondents in public and private organisations represent two statistically significant sub-groups in the data set. The theoretical framework accounts for 47.8% of the variance in behaviour of respondents in public waste organisations and 57.6% of the variance in behaviour of respondents in private organisations. The results suggest that respondents in public and private waste organisations are subject to different structural forces that shape knowledge, intention, and resultant waste behaviour.

Keywords: waste behaviour, theory of planned behaviour, learning, waste information system

5.2. Introduction

The Department of Environmental Affairs (DEA) developed and implemented the South African Waste Information System (SAWIS) in 2006, as part of the National Waste Management Strategy Implementation (NWMSI) project, a project funded by the South African and Danish Governments. The Department requires certain public and private waste organisations to report to SAWIS on the monthly tonnages of waste that they landfill, treat, and reprocess.

An empirical study conducted by the lead author in 2006 (Godfrey & Scott, 2011) explored whether SAWIS could create opportunities beyond simply being a tool for data collection. The authors examined whether collecting data for SAWIS could also build the waste knowledge of those persons tasked with the responsibility of collecting and reporting the data. The authors posited that this new waste knowledge could lead to changes in personal behaviour and ultimately changes in the way organisations manage their waste. The 2006 study, which involved interviews with participant organisations, adopted a qualitative research design, based on an interpretive approach. A theoretical framework of learning (Miller & Morris, 1999) was used to guide the research, as it supported the empirical investigation into the role of data in building knowledge. However, while the theoretical framework provided a useful means of interpreting the interview findings, the results showed that knowledge is a necessary, but insufficient condition for resultant action (Godfrey & Scott, 2011). The theoretical framework was found to be overly simplistic for understanding the role of waste data in a developing country context such as South Africa, in that it did not account for all of the evidence gathered, particularly the existence of behavioural and situational influences (Godfrey & Scott, 2011).

The authors followed up this research from 2006, with a second empirical study in 2011. The aim of this second study is to build a more conceptually inclusive theoretical framework that supports the initial research findings and provides a basis to further explore the research question “*Can the collection of data for a national waste information system change the way waste is managed in South Africa, such that there is a noticeable improvement?*” The authors present an overview of two social-psychological theories with the aim of incrementally constructing a novel theoretical framework that links the collection of waste data with behaviour change. This framework is then applied to the empirical data collected in the 2011 study. The paper focuses specifically on waste management in South Africa, a developing country in a process of social and political transformation, which faces many waste management challenges (Savage, 2009).

Given the wealth of findings from this second empirical study, the results are presented in two parts. The first paper (Godfrey *et al.*, forthcoming) re-examines the relationship between data, theory, and experience in building waste knowledge in South Africa. In this, the second paper, the authors move beyond the role of waste data in building knowledge, to examining the influence of waste data on waste management behaviour.

5.3. Theoretical framework

5.3.1. Knowledge as a precursor to action

Environmental information disclosure, science communication and environmental education are three theoretical fields that have provided significant contributions to understanding the impact of environmental information on behaviour (Weiss, 2002; Denisov *et al.*, 2005; Stephan *et al.*, 2009).

Information strategies have been successfully used internationally as policy instruments to elicit desired policy outcomes by influencing human behaviour, either directly or indirectly (Weiss, 2002; Antweiler & Harrison, 2003; Kolominskas & Sullivan, 2004). According to Weiss (2002), information can influence people's knowledge and awareness of a behaviour. Policy makers then rely on people to use their newly acquired skills to change their behaviour so as to meet the required policy intention. The underlying assumptions of information-behaviour strategies is that people respond to information out of their own accord; that people have limitless capacity to absorb new information; that people have endless motivation to alter their behaviour based on what is considered optimal behaviour; and that knowledge is linked to action (Weiss, 2002). In this approach, agency is seen to be centred on rationality and knowledge.

Scientific opinions differ between those who suggest that making data and information available to individuals can influence actions (Denisov & Christoffersen, 2001; Denisov *et al.*, 2005; Stephan *et al.*, 2005), and those who believe that a tenuous relationship, if any, exists between knowing what to do and acting on that knowledge (Finger, 1994; Miller & Morris, 1999; Pfeffer & Sutton, 2000; Weiss, 2002; Barr, 2007). Empirical research has shown that in the South African context, the collection of waste data, although not the primary driver, does positively change the way waste is managed within organisations (Godfrey & Scott, 2011; Godfrey *et al.*, forthcoming). This is what Denisov & Christoffersen (2001:4) refer to as "*changing patterns of behaviour through raising overall awareness*".

“Far more useful than information, and consequently far more difficult to obtain, is the right knowledge” (Miller & Morris, 1999:75). Empirical evidence shows the importance of knowledge as a precursor to behavioural intention and resultant action for waste recycling, composting and reuse (Fransson & Gärling, 1999; Oom Do Valle *et al.*, 2005; Barr, 2007; Mosler *et al.*, 2008). However, very few behavioural studies have taken matters further to explore the way in which knowledge supports or inhibits action. In fact, it is not clear from many studies whether the authors, when referring to knowledge, actually mean knowledge or whether they mean information. Often the two terms are used interchangeably, or reference is made to knowledge and the authors go on to discuss the importance of information campaigns or communication strategies (Mosler *et al.*, 2008; Fudge & Peters, 2011). Information is not the same as knowledge (Miller & Morris, 1999; Moeletsi & Novella, 2004). Knowledge is created in individuals through the integration of information derived from data; theory that puts that information into the correct context; and experience of real world applications (Allee, 1997; Miller & Morris, 1999; Poch *et al.*, 2004; Godfrey *et al.*, forthcoming).

The collection, interpretation and internalisation of data, can through a process of learning, raise awareness (Finger, 1994; Denisov & Christoffersen, 2001) and increase knowledge (Miller & Morris, 1999). Dominant frameworks in environmental education assume information to be the basis for generating knowledge, concern and resultant environmental awareness. When combined with value orientations, beliefs and attitudes, these have the potential to influence behaviour (Finger, 1994). The role of information in generating knowledge and raising awareness is seen as a means of changing human behaviour particularly in circumstances where environmental problems exist (McAndrew, 1993; Gardner & Stern, 1996; Denisov & Christoffersen, 2001; Jones, 2001; van Birgelen *et al.*, 2009). Trudgill (1990) recognises the lack of knowledge as a barrier to action. According to Trudgill (1990), while a person may be willing to do something about an environmental problem, their knowledge base may be inadequate, with the result that they may not know what to do to overcome the problem.

While theorists suggest that it is knowledge (and not data or information) that directly influences action, some authorities, e.g. Bandura (1982) suggest that even knowledge is insufficient to accomplish action. The examination of the relationship between data, knowledge and behaviour forms the focus of this paper.

5.3.2. Action theories and their application in waste management

Many social-psychological theories, models and frameworks have been applied in evaluating and predicting environmental behaviour (Finger, 1994; Kollmuss and Agyeman, 2002; Payne,

2002; Oom Do Valle *et al.*, 2005; Kurz *et al.*, 2007; Montada *et al.*, 2007; Wall *et al.*, 2007; van Birgelen *et al.*, 2009). Perhaps the most frequently applied and empirically proven action theory in environmental behavioural research, and certainly in understanding waste recycling behaviour, is Ajzen's (1985) theory of planned behaviour (**Figure 5-1**), (Oom Do Valle *et al.*, 2005; Kurz *et al.*, 2007; Mosler *et al.*, 2008; van Birgelen *et al.*, 2009). Kollmuss and Agyeman (2002:243) consider it to be "the most influential attitude-behaviour model in social psychology". It has been used to examine behavioural change in various fields, from health studies (particularly behavioural change with respect to HIV/AIDs, see UNAIDS, 1999; Fishbein *et al.*, 2001) to waste recycling studies (Barr, 2007; Knussen & Yule, 2008; Mosler *et al.*, 2008).

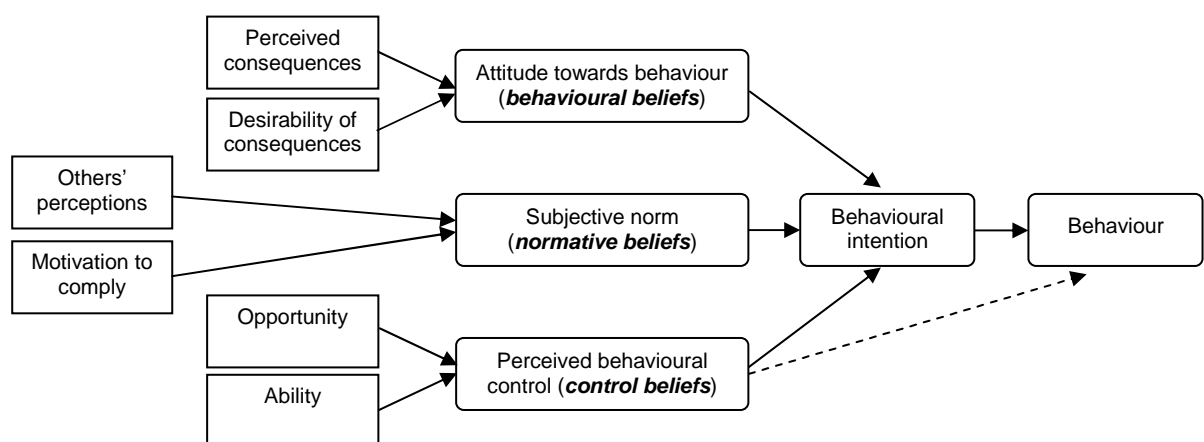


Figure 5-1. Theory of Planned Behaviour (from Ajzen, 1985; Ajzen, 1991)

The theory of reasoned action (Fishbein & Ajzen, 1975), a precursor to the theory of planned behaviour, suggests that action, represented by means of behavioural *intention*, is a function of two factors, one personal (*attitude toward the behaviour* or *behavioural beliefs*), the other social (*subjective norms* or *normative beliefs*). A person's *attitude* towards a specific behaviour is seen as a function of the perceived positive or negative consequences of performing the behaviour and the desirability of these consequences. A high correlation has been found between attitude and behaviour where there is a high awareness of consequence (Fransson & Gärling, 1999). The subjective norms relate to the social environment or social pressures, i.e. the person's perception that an individual or group important to them expects them to perform the given act. This is influenced by the person's motivation or desire to comply with the perceived expectations of that reference group or the reference group's perceived power or authority over the person (Ajzen & Fishbein, 1973; Weiss, 2002; Oom Do Valle, 2005). According to Ajzen (1985:12), "generally speaking, people intend to perform a behaviour when they evaluate it positively and when they believe that important others think they should perform it".

The theory of reasoned action maps out the causal links from personal and social beliefs, through attitudes and intentions to overt behaviour, i.e. behaviour over which a person has full control or the power of determining outcome. The theory proposes that a person's intention to perform a behaviour immediately precedes the action. Therefore, with the exception of unforeseen events, people are expected to behave in line with their intentions. Pfeffer & Sutton (2000:157) refer to this as an atomistic view, which assumes that "*individual outcomes and individual behaviour are under the control and discretion of those individuals, so that results and decisions can be reasonably attributed to individuals*".

Research has shown however, that while actions are controlled by behavioural intentions, intentions may not always manifest as action, even if the willingness is there (Ajzen & Fishbein, 1973; Ajzen, 1985; Chung & Leung, 2007). This was evident in the piloting of the SAWIS, where intentions to change the way waste is managed often did not materialise as action (Godfrey & Scott, 2011). A number of factors impact upon the manifestation of intention as behaviour; these include broadly, *changes in intention* and degree of *volitional control* (Ajzen, 1985). According to Ajzen (1985), people are more likely to succeed in performing a behaviour if they have control over that behaviour. Where a person lacks the required skills, knowledge or ability, a poor correlation may be found between behavioural intention and action. While internal influences on behaviour are perhaps easy to manage, through acquiring new skills or information, external societal factors may be outside a person's control. When a behaviour is dependent upon other people, it is likely that the person will not have full control over the implementation of the behavioural intent. Pfeffer & Sutton (2000:158) acknowledge that intentions and behaviour are highly interdependent.

Since many behaviours are not under the complete volitional control of the individual, Ajzen put forward an extension of the theory of reasoned action, namely the theory of planned behaviour (Ajzen, 1985; Ajzen, 1991), which includes a third antecedent to intention, that of perceived behavioural control (*control beliefs*) (**Figure 5-1**). Perceived behavioural control (PBC) has been described as the ease with which the behaviour can be performed, a person's perception of the difficulty of performing a behaviour (self-efficacy), or the presence and extent of factors that either facilitate or hinder performance (controllability). PBC is a person's beliefs about available resources, opportunities, and specific knowledge (Ajzen, 1991; Eagly & Chaiken, 1993; Oom Do Valle et al., 2005). Francis *et al.* (2004:9) refer to this as the "*power of both situational and internal factors*" that influence behaviour, while van Birgelen *et al.* (2009:130) refers to the "*extent to which a person thinks his or her own actions will have an impact on the situation as a whole*".

A person is more likely to act if they are confident in their *ability* to perform the action or if strong *barriers* are removed (Ajzen, 1991; Gardner & Stern, 1996). DeYoung (1993, in Gardner & Stern, 1996), in a study of waste recycling initiatives, found that while both participants and non-participants of recycling programmes had strong, positive attitudes towards recycling, non-participants considered there to be greater barriers to recycling than did participants, highlighting the importance of perceived control over behaviours. Perceived behavioural control bears strong similarities to what Bandura (1982), refers to as self-efficacy in his social cognitive theory. Self-efficacy is seen as a person's belief or confidence in their ability to perform a given behaviour (Gist, 1987; Ajzen, 1991). Many studies have reported significant correlations between self-efficacy and subsequent task performance (Bandura, 1977; Bandura & Adams, 1977; Bandura, 1982). According to Bandura (1989:59), the "*self-efficacy mechanism plays a central role in human agency*".

The five most widely accepted theories for understanding, predicting and changing human behaviour⁵ recognise the importance of a person's skills or ability as one of three factors necessary for producing any behaviour (Fishbein *et al.*, 2001; Gielen & Sleet, 2003). A strong positive intention to perform the behaviour, coupled with the removal of environmental barriers that inhibit the behaviour, and the possession of the necessary skills to perform the behaviour, are therefore held to be necessary for producing a behaviour (Fishbein *et al.*, 2001).

The value of the theory of planned behaviour is that it provides a structured framework within which to gauge the influence of data on behaviour. From this theory, the authors posit that data can influence and alter behavioural intentions, by influencing behavioural beliefs, normative beliefs and control beliefs (Ajzen, 1985; Finger, 1994; Gardner & Stern, 1996). New information may raise a person's awareness regarding the outcomes or consequences of a behaviour (or non-behaviour), thereby altering the person's attitude towards the behaviour. New information may alter a referent's awareness regarding the outcome of a behaviour, thereby placing more or less pressure on the person conducting the behaviour (change of subjective norms). A manager, for example, may be informed by new information that may alter his or her expectations regarding a subordinate's behaviour. Finally, new information can be used to increase a person's knowledge (through a process of learning), making them more capable of completing the behaviour and giving them more control over their behaviour. The theory of planned behaviour therefore suggests that data/information has the ability to influence intentions and resultant behaviour.

⁵ Behavioural theories evaluated by the National Institute of Mental Health (cited in Gielen & Sleet, 2003): the *health belief model* (Becker, 1974); the *social cognitive theory* (Bandura, 1986); the *theory of reasoned action* (Fishbein & Ajzen, 1975); the *theory of self-regulation and self-control* (Kanfer, 1970); and the *theory of subjective culture and interpersonal relations* (Triandis, 1972).

5.3.3. Hypotheses

This paper builds on the research by Godfrey & Scott (2011) and Godfrey *et al.*, (forthcoming), by expanding the theoretical framework of learning to also include a behavioural component, represented by the theory of planned behaviour (**Figure 5-2**). This combined theoretical framework allows the authors to explore the influence of data directly on waste behaviour, by examining the contribution of data and resultant knowledge to each of the three constructs of behavioural intention (attitude, subjective norm and PBC) and the influence of intention on behaviour. This relationship between data and behaviour is explored by examining the following 11 hypotheses (**Figure 5-2**).

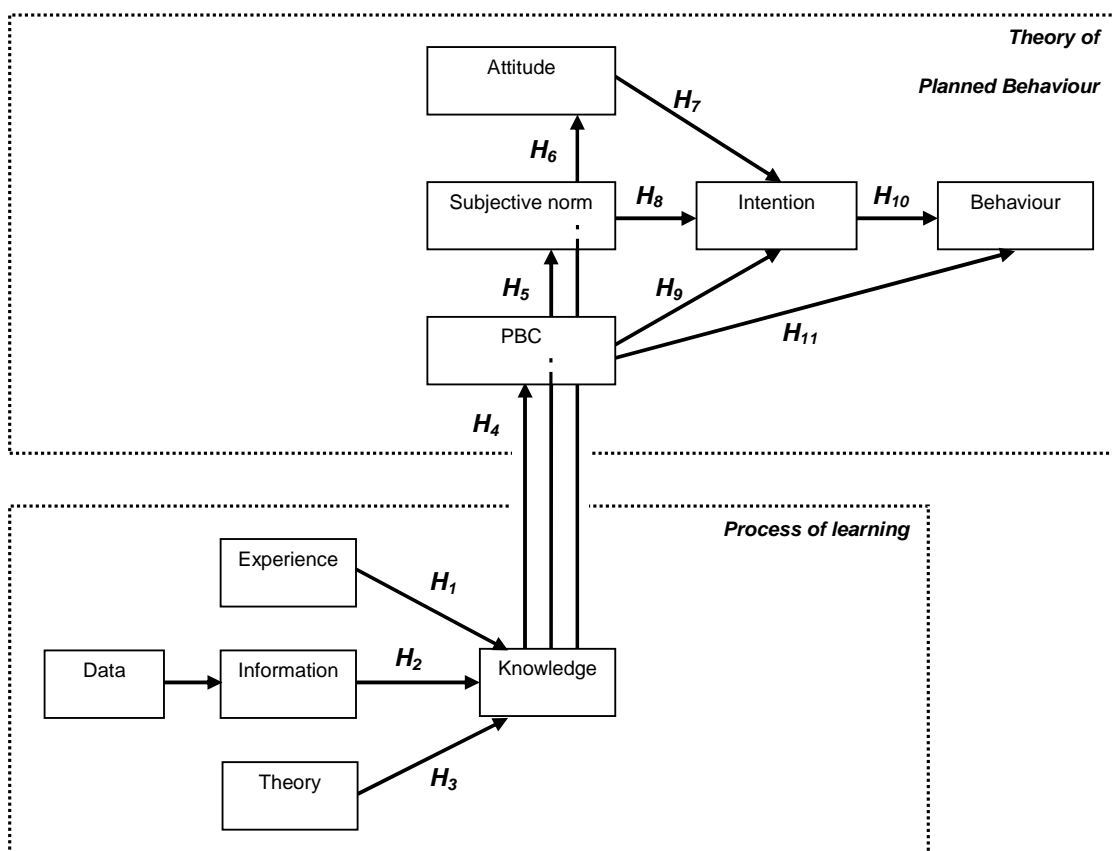


Figure 5-2. Theoretical framework of learning and the influence of knowledge on behaviour

- H1.** Personal waste experience has a positive effect on knowledge
- H2.** Waste data (and information) have a positive effect on knowledge
- H3.** Waste theory has a positive effect on knowledge
- H4.** Knowledge has a positive effect on perceived behavioural control
- H5.** Knowledge has a positive effect on subjective norms
- H6.** Knowledge has a positive effect on attitude
- H7.** Attitude has a positive effect on good waste management practice intention

- H8.** Subjective norm has a positive effect on good waste management practice intention
- H9.** Perceived behavioural control has a positive effect on good waste management practice intention
- H10.** Intention has a positive effect on actual waste management practice
- H11.** Perceived behavioural control has a positive effect on actual waste management practice

Since participating organisations have already assimilated their waste data into waste information by the time of submitting to the SAWIS, data and information are treated as a single construct for the purposes of this research.

5.4. Method

5.4.1. Participants

Participants in the research were limited to those organisations that had submitted data to the SAWIS in 2009 and 2010 (**Table 5-1**). Two main types of organisations report data to SAWIS, namely public organisations (municipalities), and private organisations (itself of two types: industrial and private waste companies). Only 32 organisations in South Africa reported to SAWIS in both 2009 and 2010. In addition, two organisations reported only in 2009, and six organisations only in 2010, giving 40 unique organisations (14 municipal, 26 private). Because of the small population size (n=40), sampling was felt to be unnecessary and all organisations were approached to participate in the research.

Table 5-1. Number of organisations reporting data to SAWIS in 2009 and 2010

Reporting year	Reporting organisations
2009	34
2010	38

For each organisation, the respondent was identified as the registered system user or person responsible for capturing and submitting the waste data to SAWIS. Of the 40 participating organisations, two were no longer contactable and seven organisations did not make themselves available to participate in the study. In certain organisations, capturing the data and uploading the data to SAWIS, has been assigned to different persons. In these cases, both persons were approached for interviews. From the 31 available organisations, 44 respondents participated in the study (15 municipal, 29 private).

In terms of participating organisational profiles, participating municipalities ranged from large metropolitan (Category A) municipalities to rural (Category B) local municipalities.

Participating private waste organisations ranged from large, multi-national companies to small entrepreneurial waste companies with less than 10 employees. As such, the findings represent a diversity of organisation types and sizes.

5.4.2. The target behaviour

According to Ajzen (2006), the behaviour of interest must be defined in terms of target, action, context and time elements. This is to ensure that all constructs relate to the same behaviour, thereby ensuring the principle of compatibility (Francis *et al.*, 2004). For the purposes of this research, the behaviour under investigation was defined as ‘*good waste management practice*’, in the day-to-day handling of waste, at facilities owned or operated by public and private waste organisations within South Africa. Although a widely used term in the waste field, a search of local and international literature could not provide a definition for ‘good waste management practice’. A definition is proposed here, building on concepts put forward in the literature (DWAF, 1998; Environmental Agency, 2001; WRAP, 2007; Republic of South Africa, 2009). Good waste management practice, as a normative concept, is defined as: “*waste activities that are compliant with waste and environmental legislation; that promote the waste hierarchy and support waste avoidance, minimisation, reuse, and recycling; and that minimise the impact of waste and possible associated pollution on the environment and human health*”.

The use of the term ‘good’ in relation to the target behaviour, does raise concerns around the potential for social desirability bias (Timlett & Williams, 2008), or the tendency for respondents to reply to a question in a manner that is viewed favourably by others. It was considered that the target behaviour be changed to ‘sustainable waste management practices’ which is also widely used within the waste field, and for which a definition was equally elusive. However, ‘sustainable’ similarly provides the same risk of social desirability bias.

5.4.3. Research design

The research adopts a mixed-methods design, combining both quantitative and qualitative research methods in a one-phase or parallel design (Gelo *et al.*, 2008; Teddlie & Tashakkori, 2009). While many theorists recognise the incompatibility of positivist and interpretive philosophical paradigms in mixed-methods research (Guba & Lincoln, 1994), this research adopts a pragmatic paradigm (Gelo *et al.*, 2008; Teddlie & Tashakkori, 2009). The pragmatic approach rejects the either/or philosophy of the positivist and interpretive theorists, instead adopting a context-driven approach where the research method is chosen based on the research question and purpose (Gelo *et al.*, 2008; Teddlie & Tashakkori, 2009). In so doing, proponents

of mixed methods research acknowledge that quantitative and qualitative research methods exist along an interactive continuum (Newman *et al.*, 2003; Teddlie & Tashakkori, 2009).

A mixed-methods research design was adopted for this research for a number of reasons. First, it is appropriate given the research question and purpose – to seek understanding of the influence of waste data on good waste management practice in South Africa (Godfrey & Scott, 2011). Second, a single influence on behaviour, amongst a multitude of influences, such as the case of data on behaviour, is difficult to observe and to quantify (Denisov and Christoffersen, 2001, Jones 2001). Third, the theoretical framework (**Figure 5-2**) includes two causal positivist theories – the process of learning and the theory of planned behavioural. As a linear action theory, the theory of planned behaviour has typically been applied within a positivist, quantitative approach. To place this research in context in terms of international literature, a quantitative analysis is necessary. However, quantitative methods have their limitations in this study, given the small population size (n=40) and the resultant limitations in statistical analysis. By adopting a mixed-methods research design, the authors aim to explore the relationships between the theoretical constructs by means of quantitative data (and associated statistical analysis), while at the same time seeking a deeper understanding in these relationships through the rich qualitative data. In this way, a fuller picture is obtained as to the role of data in changing waste behaviour in South Africa. Mosler *et al.* (2008) found a mixed research method particularly appropriate in exploring factors influencing waste behaviour in the developing country of Cuba.

Data were collected by means of one-hour, semi-structured interviews, during which time a questionnaire was administered (**Annexure 2**). The questionnaire consisted of two parts, Part I being a questionnaire of 57 closed questions and Part II being an interview schedule of 11 open questions to guide the discussion. All responses were obtained by means of self-reports. Empirical studies using the theory of planned behaviour have typically relied on self-reported behaviour, despite evidence to suggest the vulnerability of data to self-presentational biases (Armitage & Connor, 2001). Exaggerated self-reports have been found in numerous studies where the tested behaviour is seen as being socially desirable, as in the case of waste recycling (Tonglet *et al.*, 2004; Kurz *et al.*, 2007; Timlett & Williams, 2008). Given the nature of the target behaviour in this study, the possibility exists for social desirability bias in responses. For this reason, the participating landfill sites, treatment facilities and reprocessing plants were visited by the author to observe current waste management practices. Furthermore, possible self-reported biases were addressed by utilising a mixed-methods approach, which creates the opportunity for convergence triangulation and corroboration of results through the independent analysis and interpretation of both the quantitative and qualitative data (Gelo *et al.* 2008).

5.4.4. Statistical measures

All constructs were measured by means of a seven point semantic differential scale, ranging from 1 to 7 (strongly disagree/strongly agree). Positive and negative adjective endpoints were, where possible, swapped to reduce pattern developed responses (Ajzen, 2006). Questions assessing the same construct were interspersed with those of other constructs to ensure a non-systematic order to the questions, thereby reducing the chance for response bias on sets of questions (Ajzen, 2006).

The reliability of each set of questions (i.e. instrument) was assessed using Dillon and Goldstein's rho (ρ) as recommended by Tenenhaus *et al.* (2005), Henseler *et al.* (2009) and Vinzi *et al.* (2010). Dillon and Goldstein's rho is a composite measure of internal consistency reliability that is well-suited to the partial least squares path modelling method of analysis used here. For exploratory work, ρ should be equal to or greater than 0.7 (Vinzi *et al.*, 2010). Dimensionality was assessed using the size of the first eigenvalue relative to the second. Instruments are considered to be unidimensional if the first eigenvalue is greater than one, and the second eigenvalue less than one; or if the first eigenvalue is much greater than the second. Although it is no longer considered to be a good measure of reliability (Sijtsma, 2009), Cronbach's alpha (α) is also reported, since it is still widely used.

5.4.4.1. Learning theory

The three constructs of knowledge, namely data, theory, and experience were each measured by means of two items. All three instruments are shown to be unidimensional (**Table 5-2**). The internal consistency reliability for the construct 'experience' is adequate to good, for 'theory' is excellent, and for 'information' is good to very good (**Table 5-2**).

Five items were used to measure the influence of 'knowledge' on attitude, subjective norms and perceived behavioural control. The instrument is unidimensional and internal consistency reliability is very good (**Table 5-2**).

5.4.4.2. Theory of planned behaviour

Three items were used to measure *attitude*, two instrumental and the third making use of the good-bad adjective pairs, noted by Ajzen (2006) to give a good overall evaluation of attitude. Including experiential questions was not felt to be appropriate given the target behaviour under consideration.

Table 5-2. Summary statistics and quality indices for the Partial Least Squares Path Model

LV (ξ)	LV-type	Summary of Inner Model					Reliability / Dimensionality			
		MVs	R ²	TotEff _B	Av.C	Av.R	α	ρ	Eig.1st	Eig.2nd
E	Exogen.R	2	na	0.2850	0.6704	na	0.530	0.810	1.360	0.640
D/IN	Exogen.R	2	na	0.1527	0.8428	na	0.816	0.916	1.689	0.311
T	Exogen.R	2	na	0.0860	0.8736	na	0.862	0.935	1.757	0.243
K	Endogen.R	5	0.5407	0.6114	0.6736	0.3642	0.877	0.912	3.378	0.834
A	Endogen.R	3	0.4523	0.0930	0.7129	0.3224	0.799	0.882	2.143	0.531
PBC	Endogen.R	8	0.6948	0.6486	0.5668	0.3938	0.887	0.912	4.537	1.069
S	Endogen.R	5	0.5578	0.0110	0.5914	0.3299	0.819	0.876	2.959	0.869
I	Endogen.R	2	0.6468	0.2201	0.8269	0.5348	0.791	0.905	1.654	0.346
B	Endogen.R	3	0.5370	na	0.7474	0.4014	0.832	0.899	2.245	0.439

Model of Goodness of Fit (GoF)	Value
Absolute	0.6221
Relative	0.8880
Outer model	0.9984
Inner model	0.8894

Abbreviations: LV = latent variable/construct; MV = measurement variable; Exogen.R = Exogenous, Reflective; Endogen.R = Endogenous, Reflective; MVs give the number of MVs (items/indicators/measurement-variables) in the construct/LV; R² is the coefficient of determination or variance explained; TotEff_B is the total effect on B (sum of direct and indirect effects); Av.C is the average communality (communality index) and is the same as the average variance extracted (AVE, not shown separately); Av.R is the average redundancy (redundancy index); α_{std} is Cronbach's alpha (standardized); ρ_{dg} is Dillon-Goldstein's (or Jöreskog's) rho (aka composite reliability); Eig.1st/Eig.2nd are the first and second eigenvalues from a principal component analysis of the standardized manifest variables (*i.e.* items/indicators of the construct).

Five questions were used to measure *subjective norm*, two injunctive ($\bar{x} = 5.94$; SD = 1.40) and three descriptive ($\bar{x} = 5.72$; SD = 1.31). There has been a move, in the literature, towards including descriptive subjective norm questions as they are felt to give a better indication of subjective norms (Dohnke *et al.*, 2011). While internal consistency reliability of the construct is good ($\rho = 0.876$), there is a likelihood that an element of multidimensionality exists in this instrument (even after sharpening), given the very nature of the questions and the existence of a duality in the management of waste in South Africa. Descriptive and injunctive norms influence behaviour based on different motives (Klein & Boster, 2006). When asked “*whether people important to you think you should*” respondents generally look internally as to what constitutes morally approved conduct (Klein & Boster, 2006). When asked “*the people who are important to me implement*” or “*other organisations like mine implement*” respondents look externally and see evidence that other waste professionals or other waste companies are not implementing good waste management practice in the country. This is likely to result in injunctive and descriptive social norms measuring different things and hence a multidimensionality to the construct. This is summed up in the response by Respondent 4: “*if you want an example of how a solid waste site should be run, then come and visit [our site] and if you want an example of how something should NOT be done, then go and look at [the municipal] solid waste site.*”

The literature presents very conflicting results on the relationship between injunctive and descriptive norms and behavioural intention; and whether they measure the same or different things (Klein & Boster, 2006; Dohnke et al., 2011). “*The data raise the point that descriptive norms may not be correlated strongly with behaviour. Instead, the data indicate that injunctive norms are strong predictors of behaviour.*” (Klein & Boster, 2006; 22). Dohnke et al., (2011) however, found the opposite to be true, where “*the descriptive norm had a higher predictive value than the subjective norm, suggesting that perceiving others’ behaviour is of greater importance for the formation of an intention than perceiving their expectations.*” (Dohnke et al., 2011:287). However, over which there does appear to be agreement, is that measuring for both provides a broader conceptualisation of social norms and increases variability in its measure. Since they can potentially measure different things, one must be vigilant for possible attenuation of conflicting scores.

Eight items were used to measure *PBC*, three questions measuring capability ($\bar{x} = 5.95$; SD = 1.14) and five questions measuring controllability ($\bar{x} = 5.70$; SD = 1.44). The instrument is unidimensional and internal consistency reliability is very good ($\rho = 0.912$) (**Table 5-2**).

Intention was measured using two items and *behaviour* using three items. Both instruments are unidimensional and internal consistency reliability is good to very good ($\rho = 0.905$; $\rho = 0.899$) (**Table 5-2**).

5.4.5. Analysis and interpretation

5.4.5.1. Quantitative data

Traditional structural equation modelling (SEM), often applied to the analysis of the theory of planned behaviour, is a large-sample method, requiring in this case a minimum of 480 respondents (Stevens, 2009; Henseler et al., 2009). Due to the small population size of this study ($n=40$), partial least squares (PLS) was instead used to analyse the data, using the *plspm* package (Sanchez & Trinchera, 2010). Traditional SEM makes strong distributional assumptions, while the PLS method, in contrast, makes few assumptions and is suitable for use with small to very small data sets (Henseler et al., 2009). PLS path modelling is component-based whereas SEM is covariance-based; however, the results of the two methods are often similar (Tenenhaus, 2005; Vinzi et al., 2010). The results of the PLS structural model were validated using the bootstrap to derive standard errors (SEs) and confidence intervals (CIs). The confidence intervals effectively allow one, notably, to determine whether the model coefficients are significantly different from zero. Overall, there was good to very good agreement between the estimated coefficients and the bootstrapped coefficients. The authors are therefore confident

in the quality of the measuring instruments and the method of analysis used. The method of analysis advocated by Francis *et al.* (2004), in which the latent variables are estimated by taking the mean value of the manifest (or measurement) variables, gave results similar to those of the PLS analysis.

During the interviews, it became apparent that there could be significant differences in responses by respondents from the two types of organisations, i.e. public and private. To test whether this was so, a segmentation-tree analysis (Sanchez, 2009) was carried out. Segmentation trees are a type of classification and regression tree, specifically adapted for use with the PLS path modelling method. The type of organisation (whether municipal or private) was found to provide the basis for a significant split in the data set ($p = 0.0008$). What this means is that, although the structural/theoretical model in the two parts is the same, the path or regression coefficients (or some of them) that index how the latent variables influence each other are different (at the 5% level of significance), based on a modified F-test. Hence, there are different forces and intensities at work in the two types of waste organisations. In particular, the coefficients for K, PBC, S, I, were all found to be significantly different at the 10% level (the first three, at the 5% level). This distinction between organisational type is shown to be significant in the analysis of the data. Partial least squares path models were fitted to the two parts of the data set identified above, giving rise to two local models, one for municipal organisations, the other for private organisations.

5.4.5.2. *Qualitative data*

The interpretation of the qualitative involved a number of stages. All interviews were transcribed, providing a large body of qualitative data, which were then coded and categorized into a small set of pertinent themes (Leedy and Ormond, 2005). These themes were derived from the objectives of the study, as well as through an inductive and highly interpretive process of seeking meaning in the data. Content analysis (Whitley, 2002; Henning, 2004) was applied in interpreting the data, which allowed the authors to delve into the understanding and beliefs of respondents. The results of the qualitative data analysis are presented in a discussion section, following the statistical results. This allows for the results of the qualitative data analysis (presented as statistics, narrative, and themes), to be woven into a discussion together with the results of the quantitative data analysis.

5.5. Results

5.5.1. Statistical analysis of quantitative data

5.5.1.1. Global model

The statistics related to the fitted structural model are given in **Tables 5-2** and **5-3**. A relative goodness of fit (GoF) of ≥ 0.9 is considered by Vinzi *et al.* (2010) to indicate a reasonably well supported model. The overall assessment is that the structural model presented here is sound. Dillon-Goldstein's ρ_{dg} which is preferred to Cronbach's α for assessing internal consistency reliability (Sijtsma, 2009), is good to very good across all latent variables, with all variables having values of well above 0.7, considered by Vinzi *et al.* (2010) to be indicative of homogeneous instruments.

If we consider total effects (direct plus indirect effects) (**Table 5-3**), it is evident that there are only three regressors or constructs that have coefficients that are significantly different from zero (5% level), namely experience, knowledge, and perceived behavioural control. These are the only constructs that have a significant effect on behaviour, with total effects of 0.285 (experience), 0.611 (knowledge) and 0.649 (perceived behavioural control). Of these three constructs, only perceived behavioural control has a direct effect.

Table 5-3. Total effects (β) and R^2 (structural model) from a partial least squares path model of factors that influence waste management behaviour

Influencing construct	Influenced Construct								
	E	IF	T	K	A	PBC	SN	I	B
E				0.4661	0.3135	0.3885	0.3481	0.3121	0.2850
D/IN				0.2497	0.1679	0.2081	0.1865	0.1672	0.1527
T				0.1407	0.0946	0.1173	0.1051	0.0942	0.0860
K					0.6726	0.8335	0.7469	0.6697	0.6114
A								0.4228	0.0930
PBC								0.4177	0.6486
SN								0.0498	0.0110
I									0.2201
R^2				0.5407	0.4523	0.6948	0.5578	0.6468	0.5370

^{*)} Where R^2 , the coefficients of determination, is the variance explained.

Where E (experience); IF (information); T (theory); K (knowledge); A (attitude); PBC (perceived behavioural control); SN (subjective norms); I (intention) and B (behaviour)

The structural model (**Figure 5-3**) shows that of the three antecedents to knowledge, experience ($\beta = 0.466$) has the greatest influence on waste knowledge creation (**H₁**), with minor influences from information ($\beta = 0.250$) and theory ($\beta = 0.141$). Together the three variables account for 54.1% of the variance in knowledge ($R^2=0.541$). Knowledge has a significant influence on all three of the antecedents to behavioural intention (**H₄**, **H₅**, **H₆**) – attitude, subjective norm and

most of all, perceived behavioural control. Knowledge accounts for 69.5% of the variance in PBC, relating to the aspect of capability within this variable.

The three belief constructs (A, SN, PBC) account for 64.7% of the variance in behavioural intention (**Figure 5-3**). This is higher than that typically found in other empirical studies. Meta-analyses and specific studies, referenced in the literature, have shown the theory of planned behaviour constructs to account for significant variances in behavioural intention, from 49.7% (Nigbur *et al.*, 2004); 39% (Armitage & Conner, 2001); 32% (Perugini & Bagozzi, 2004); to as low as 26% (Tonglet *et al.*, 2004). While intention and PBC show a reasonable correlation with behaviour they account for only 53.7% of actual waste management behaviour, suggesting significant additional influences on behaviour not accounted for in this theoretical framework.

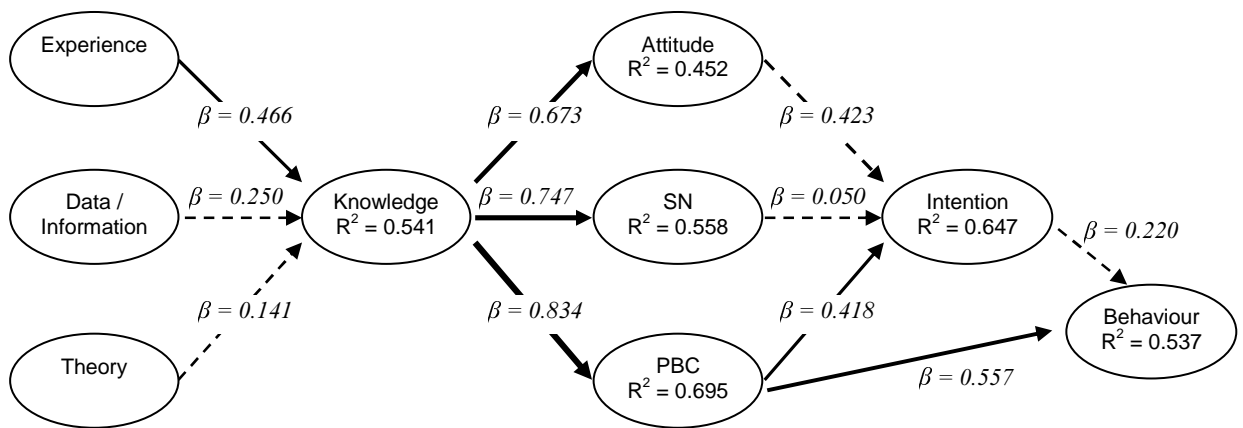


Figure 5-3. Path diagram for the global model, fitted to the imputed data set using sharpened instruments

*) Where β represents the regression coefficients and R^2 the coefficients of determination. Line weight is proportional to effect-size and to the degree of confidence in the link; broken lines indicate no influence (insufficient evidence to reject the null hypothesis that the coefficient is zero, i.e. $H_0 : \omega = 0$ at the 5% level of significance). Line weight for unbroken paths is proportional to the lower bound of the associated confidence interval.

However, from the structural model, it is evident that it is PBC and not intention that has the greatest influence on behaviour, with PBC having more than two-and-a-half times the influence on behaviour as behavioural intention. So while respondents may have an intention to act, this intention is not manifest as actual waste behaviour. Instead, the statistics suggest that capability and controllability, the two components of PBC, have the greatest influence on actual waste management behaviour in this case study. Since experience is shown to have the greatest influence in the development of knowledge or capability, it resultantly has a significant influence on ultimate waste management behaviour.

Waste data does not have any significant influence directly on behaviour ($\beta=0.499$), with data explaining only 24.9% of the variance in observed behaviour (**Figure 5-4**). This is supported by Godfrey *et al.*, (forthcoming), who found that while collecting waste data has a positive impact on the way organisations manage their waste, it is not the data that causes the operational response in organisations, but rather resultant waste knowledge.

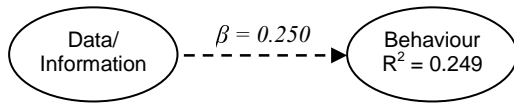


Figure 5-4. Path diagram for the structural model showing effect of data directly on behaviour

5.5.1.2. Local models

The pathmax algorithm reveals that there are two sub-groups in the data set (**Figures 5-5 and 5-6**), and that these two sub-groups are subject to significantly different influences, impulses and behaviours. Given the small population size, and even smaller sub-population size, validation of these results should be undertaken in future research when the population of respondents submitting data to SAWIS has significantly increased.

The *Municipal* local model (**Figure 5-5**) shows that knowledge is influenced mostly by theory and information, with 49.5% of the variance in knowledge explained by learning theory. Knowledge has a strong influence on all three theory of planned behaviour beliefs, however only PBC has a significant influence on both intention and behaviour, twice the influence on behaviour as behavioural intention. Only 47.8% of the variance in behaviour can be explained by the combined theoretical framework.

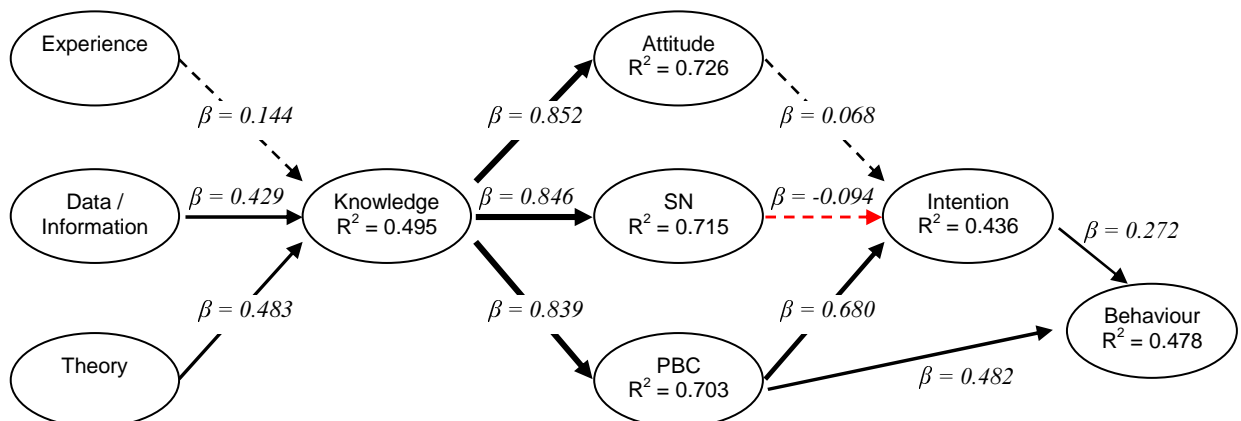


Figure 5-5. Path diagram for the *Municipal* local model, fitted to the imputed data set using sharpened instruments.

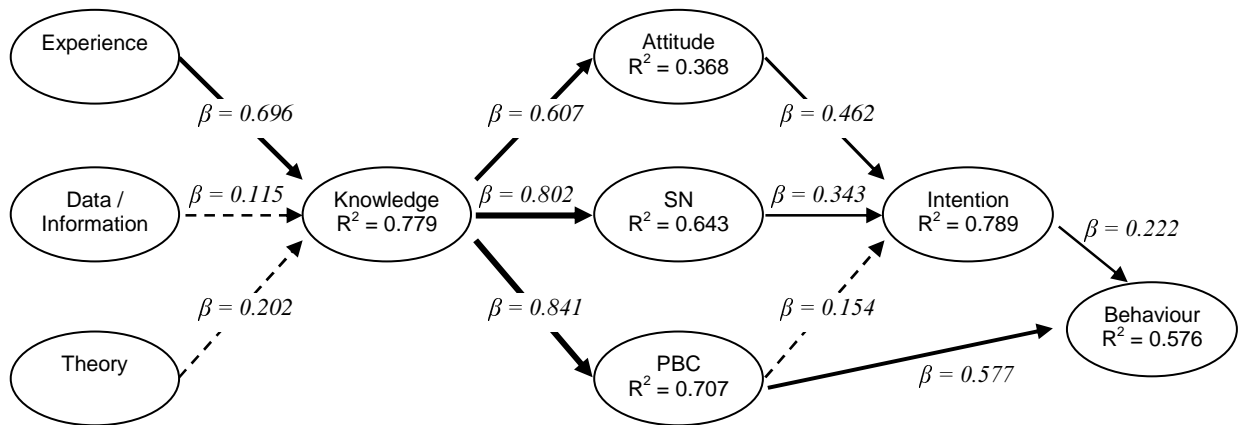


Figure 5-6. Path diagram for the *Private* local model, fitted to the imputed data set using sharpened instruments

The *Private* local model (**Figure 5-6**) shows that knowledge is influenced mostly by experience, with 77.9% of the variance in knowledge explained by learning theory. Knowledge has a strong influence on all three theory of planned behaviour beliefs, however only attitude and subjective norms have an influence on intention. PBC has a direct impact on behaviour, more than twice the influence on behaviour as behavioural intention. While more of the variance in waste management behaviour in private organisations can be explained by the combined theoretical framework, this accounts for only 57.6% of the variance.

Given the mixed-methods research design, the qualitative data provides increased confidence in the findings of the statistical analysis. However, since our research interest is in understanding the relationships between data, knowledge, and behaviour and not simply in predicting behaviour, the qualitative data provides further insights into, and deeper understanding of these relationships, providing reasons for the patterns not explained through the quantitative data.

5.5.2. Qualitative analysis of beliefs, intention and behaviour

5.5.2.1. Knowledge

The role of data, theory and experience in the creation of waste knowledge is discussed in some detail by Godfrey *et al.* (forthcoming). Content analysis of the qualitative data shows that 67.7% of all first responses to the open question on means of learning favour experience, 25.8% favour theory and 6.5% favour data/information. While theory and data are less significant in building knowledge from both the quantitative and qualitative data analysis, their order of significance differs between the methods of analysis, with the qualitative data showing a greater influence of theory on respondent's learning than data/information. Experience is the dominant means of learning for both private (73.7% responses) and municipal (58.3%) respondents, while

theory has a greater influence for municipal respondents (33.3%) than for private respondents (21.1%). Data/information plays a minor role for both municipal and private respondents, at 8.3% and 5.3% respectively.

5.5.2.2. Attitude

Attitude is seen in the global model (**Figure 5-3**) to have a strong influence on behavioural intention, supporting hypothesis **H₇**. However, the local models show marked differences in the attitude of respondents towards good waste management practice in public and private organisations, with attitude playing an insignificant role in the behavioural intention of municipal respondents. This finding is supported by the content analysis of the qualitative data. A factor that relates to both attitude in terms of perceived consequence, and subjective norms in terms of social pressure, is the mindset of respondents regarding consequence or compliance. In interviewing respondents, it became very clear that issues of legal compliance were part of the vocabulary of respondents from private organisations when compared to public respondents (i.e. a compliance discourse was evident). This was assessed by counting the number of times a respondent, without prompting, made mention to one of the following words in the interview transcript – compliance/comply; permit/licence; legal; audit; Green Scorpions⁶; and legislation. It was found that on average, respondents from municipalities referred to these compliance terms only six times in an interview, respondents from private industries on average 10 times, and respondents from private waste companies on average 14 times.

Respondents from private companies appear to be more concerned about, and under greater pressure to ensure legal compliance of waste operations. Respondents from the private sector made reference to the Green Scorpions 10 times, whereas the municipal respondents did not make reference to them at all. This supports a growing concern within the private sector that government and the Green Scorpions are targeting private waste facilities at the near neglect of municipal facilities, creating inconsistencies in enforcement and dual enforcement standards for public and private waste facilities (Bosman and Boyd, 2008; Engledow and Groeners, 2008). This focus by regulators on the private sector is well summed up by Respondents 22 and 33: *“They generally pick on industry, but when it comes to municipalities there’s no action taken, they just carry on. So, it makes us rather despondent because we feel that there’s both an environmental need as well as a financial implication to managing waste correctly, but it only seems to apply to industry”* (Respondent 33). *“I think lack of enforcement, I can’t say in [our] case because we’ve been audited to death. But a lack of enforcement with other companies and municipalities definitely; I think they just carry on and do their own little thing”* (Respondent

⁶ The Green Scorpions, as they are popularly known, are environment enforcement officers, mandated to monitor compliance with, and enforce of, environmental legislation in South Africa.

22).

This compliance discourse within the private waste sector creates a strong organisational culture and attitude towards implementing good waste management practice. As noted by Respondent 22 *“There’s a very strong compliance message within the group. You can’t not be compliant in this. We’ve got such a culture of compliance in the company at the moment, that’s all I can say.”*

5.5.2.3. Subjective norms

In the application of the theory of planned behaviour, subjective norms are often found to hold the weakest relationship with behavioural intention (Armitage & Connor, 2001; Klein & Boster, 2006; Dohnke *et al.*, 2011). Personal beliefs are therefore considered to overshadow normative beliefs, or perceived social pressure, in the formation of behavioural intentions (Ajzen, 1991). A meta-analysis of the theory of planned behaviour shows subjective norms to be less predictive of intention than both attitude and perceived behavioural control (Dohnke *et al.*, 2011).

Subjective norms have a very weak influence on behavioural intention in both the global and local models. An analysis of the subjective norm closed questions shows a noticeable difference between responses from municipal respondents ($\bar{x} = 5.31$; $SD = 1.46$) and private respondents ($\bar{x} = 6.07$; $SD = 1.21$). Municipal respondents only slightly agree that ‘important others’ think they should implement good waste management practice. We also see a greater variation in municipal responses, with more municipal respondents strongly disagreeing that ‘important others’ think they should implement good waste management practice. This differs from private respondents who on average have a greater sense that ‘important others’ think good waste management practice is important.

This difference between public and private organisations is also evident in the responses to the open-ended question: *“People who are important to me think that I should implement good waste management practices in my organisation”*. Certain municipal respondents feel that there is no sense from ‘important others’ that good waste management practice should be implemented in the municipality (Respondent 6, 15). *“There’s no pressure from colleagues to implement good waste management practice”* (Respondent 6). *“Nobody worries about waste, nobody is interested in it. They don’t give you the support, you’re on your own”* (Respondent 15).

Some municipal respondents feel that Council and senior management in the municipality expect good waste management practice to be implemented, but do not provide staff with the

resources or authority to do so. So long as waste is removed from the streets and there are no incidences, such as illegal dumping, strikes, non-collection, etc, waste receives little priority. *“The executive directors they expect that you should implement as per legislation. It’s an expectation that they don’t fulfil because they don’t give you the tools to implement that. I strongly agree with implementing [good waste management practice] but it goes hand in hand with the means for you to be able to achieve that”* (Respondent 9). We see the three constructs of the theory of planned behaviour within this single statement of Respondent 9. A strong attitude to want to implement good waste management practice, and a sense from those important to him that good waste management practice should be implemented. However, converting intention to action is constrained in terms of perceived behavioural control, and in particular, controllability. This is evident in a number of statements made by respondents in municipalities:

“They feel like it’s a normal operation. So long as [waste management is] done, it’s ok, even if sometimes it’s not done up to standards” (Respondent 13).

“Oh yes, they want a fully nice excellent service, for sure they want it, council and the people, both. They want it, but they do not provide sufficient resources” (Respondent 14).

“As long as [waste is] taken away from our streets, it’s taken away from our house. They don’t give you the support. You’re on your own” (Respondent 15).

“Everybody theoretically agrees that legislation must be applied and the place must be clean. However, the same people who require that service to be rendered take the decision not to fund those services. And then I think there’s a conflict of interest, where people are sending signals that they require this top grade service, yet they don’t send the funding that actually ensures that you can do that” (Respondent 18).

“I think the people that we work with do feel that we should implement good waste management practice, and they actually sometimes think we do, although I don’t think so” (Respondent 19).

This is different to what is evident in private industry and private waste companies where there appears to be a strong organisational culture of implementing good waste management practice driven from the highest levels of management.

“I don’t think its pressure, I think it’s a common responsibility that we all feel towards it and I think we all feel obligated to do the right thing. It’s more a cultural issue. I’m talking of the CEO, so from that level you have the support and it trickles down all over the organisation” (Respondent 3).

“Having that good waste management is a culture that’s been entrenched in the

company and I also see it's something that gets driven from the top down. You should be trying to implement good waste practices, it's important. It's something that's being discussed at management meetings, and discussed above us at board level" (Respondent 8).

This organisational culture is often found in response to the compliance discourse (Respondent 3, 5, 22, 36), but also in response to maintaining certain organisational ratings, e.g. ISO certification (Respondent 5, 22), or environmental rating systems (Respondent 16). The organisations public image, e.g. Stock Exchange listings (Respondent 4), or business sustainability and profitability (Respondent 4, 25) are also seen as strong drivers of organisational pressure to implement good waste management practice. *"If the company is a Johannesburg Stock Exchange listed company, something in the public eye, then yes I would strongly agree, [good waste management practice] is something that's driven very, very hard within industry"* (Respondent 4).

5.5.2.4. Perceived behavioural control (PBC)

Ajzen's theory of planned behaviour posits that the stronger the intention to act, the more likely the intention will translate into actual behaviour (Ajzen, 1991). There is considerable doubt amongst social psychologists as to whether intentions are consistent with behaviour (Bell *et al.*, 1990; Fishbein *et al.*, 2001). Ajzen (1991) qualifies this position in that intention is manifest as behaviour only where the behaviour is under volitional control. Both motivation (intention) and ability (behavioural control) are required for action. According to the theory, PBC will become increasingly important as volitional control over the behaviour decreases (Ajzen, 1991). Similarly, the correlation between intention and PBC and actual behaviour is shown by Ajzen (1991) to decrease as volitional control decreases. This 'discrepancy' between intention and behaviour, seen in many environmental behaviour studies, is often referred to as the value-action gap (Chung & Leung, 2007, Burgess *et al.*, 2005, cited in Barr, 2007).

In the global model, PBC is the dominant influence on behavioural intention and behaviour (**Table 5-3**). As with the other constructs of the theory of planned behaviour, differences are evident in the effect of PBC in the local models. While PBC is the dominant influence on both behavioural intention and behaviour for municipal respondents, for private respondents PBC has little influence on intention, its dominant influence being on behaviour.

The theory of planned behaviour has been criticised for not making adequate allowance for the effect of past behaviour on current behaviour (Ajzen & Fishbein, 2005; Norman, 2011). Norman & Smith (1995, cited in Ajzen & Fishbein, 2005) showed that by including past

behaviour as a separate predictor of current behaviour, variance in behaviour could be increased from 41% to 54%, considered to be significant by Ajzen & Fishbein (2005). Ajzen (1985) also suggested that past performance of a behaviour influences current behaviour independently of intention, attitude and subjective norms. By combining the two theoretical frameworks, this research suggests that past behaviour is already accommodated. Past behaviour can be considered to build experience (experiential learning), which we see in this case study to be the most significant contributor to building knowledge. Knowledge has a significant effect on PBC, and PBC a significant effect on waste behaviour. Past behaviour and experience therefore has a significant influence on behaviour via the knowledge and PBC constructs.

In terms of the two components of PBC, capability and controllability, Godfrey *et al.*, (forthcoming) show the strong influence of knowledge (capability) on PBC and waste behaviour (**Table 5-3**). However, from the qualitative data, there is evidence that controllability also appears to have a significant influence on behaviour. The influence of controllability is captured in these statements by respondents:

“the control over implementing good waste management practice is a function of how high you are in the organisation, it's not a function of the amount of knowledge that you have. You're in a food chain, your ability to do something is only determined by your rank in the food chain” (Respondent 4).

“Sometimes it's challenging because your boss must give you a go ahead to do something. So you cannot just do things on your own. The powers to make final decisions, we must discuss first. We make decisions on the ground and then we've got to elevate them to be ratified. So we cannot just make final decisions. Unless they're minor issues which we've been given powers to” (Respondent 28).

5.5.2.5. *Intention*

The results, for both the global and local models, show a weak relationship between intention and behaviour. Good waste management intention is therefore not always being translated into actual waste management practice in this case study. As per Ajzen (1991) these results suggest that good waste management practice is not completely under the volitional control of those tasked with its implementation, in both public and private organisations.

The correlation between intention and behaviour ($r = 0.63$) is somewhat higher than that found in other studies. Meta-analyses covering diverse behaviours report mean intention-behaviour correlations of 0.62 (van den Putte, 1993); 0.44 to 0.56 (Albarracín, Johnson, Fishbein, & Muellerleile, 2001; Godin & Kok, 1996; Hausenblas, Carron, & Mack, 1997; Sheeran & Orbell, 1998); 0.53 (Shepherd, Hartwick, & Warshaw, 1988); 0.53 (Sheeran, 2002); 0.47 (Armitage &

Conner, 2001; Notani, 1998); and 0.45 (Randall & Wolff, 1994) (*all cited in Ajzen & Fishbein, 2005*).

5.5.2.6. *Direct influence of data on behaviour*

The statistical results provide evidence of a weak direct relationship between data and behaviour. The relationship between data and behaviour was explored in this study by means of two closed and two open questions. Closed questions, measured on a seven point semantic differential scale, included: “*Collecting waste data within my organisation has had a positive impact on the way we manage waste*” and “*Collecting waste data, specifically for reporting to the SAWIS, has a positive impact on the way our organisation manages waste*”. The two open-ended questions were: “*In your opinion, has anything changed in the way your organisation manages its waste because of data collection, and more specifically data collection for SAWIS?*” and “*Why do you (agree/disagree) that collecting data within your organisation has a positive impact on the way your waste is managed?*”

A statistical analysis of the two closed questions measuring the direct impact of data on behaviour shows that respondents, on average, slightly agree that data has had a positive impact on the way they manage waste ($\bar{x} = 5.33$; $SD = 1.67$). When asked in the open questions whether respondents felt if anything had changed in the organisation because of waste data collection, 37.5% of respondents felt that data had resulted in both an impact and a change, 18.8% felt there had been neither an impact nor a change, while 43.8% of respondents felt that data had had an impact, but that nothing had changed in the organisation. There are therefore mixed responses as to whether data has in fact led to a direct behavioural response in the way waste is managed in the organisation (Respondent 31, 38). Most respondents felt that the impact of the data was in simply ‘knowing’ the quantities and types of waste received (Respondents 6, 8, 13, 15, 16, 19, 29), in supporting planning and management of waste (Respondents 7, 17, 24), or in monitoring of waste (Respondents 14, 18). The influence of data can therefore be understood as part of knowledge building, which, when combined with experience and theory, is applied to the management of waste.

5.6. **Conclusions**

Combining the process of learning and the theory of planned behaviour into a refined theoretical framework, provides an opportunity to further explore the research question “*Can the collection of data for a national waste information system change the way waste is managed in South Africa, such that there is a noticeable improvement?*” Fitting the data to this theoretical framework shows that there are only three regressors that have a significant effect on behaviour,

namely experience, knowledge and perceived behavioural control. Experience is shown to have the greatest influence on building waste knowledge in this case study, with minor influences from information and theory. Together the three variables account for 54.1% of the variance in knowledge.

Knowledge has a significant influence on all three of the antecedents to behavioural intention – attitude, subjective norm and most of all, perceived behavioural control. From the structural model, it is evident that it is perceived behavioural control and not intention that has the greatest influence on waste behaviour. So while respondents may have an intention to act, this intention does not always manifest as actual waste behaviour. The results suggest that capability and controllability, the two components of perceived behavioural control, have the greatest influence on actual waste management behaviour in the case study. Since experience is shown to have the greatest influence in the development of knowledge or capability, it resultantly has a significant influence on actual waste management behaviour. The structural model supports hypotheses **H₁**, **H₄**, **H₅**, **H₆**, **H₉** and **H₁₁**, namely, that personal waste experience has a positive effect on knowledge; knowledge has a positive effect on perceived behavioural control; knowledge has a positive effect on subjective norms; knowledge has a positive effect on attitude; perceived behavioural control has a positive effect on good waste management practice intention; and perceived behavioural control has a positive effect on actual waste management practice.

Municipal and private organisations are shown to represent two statistically significant sub-groups in the data set. For the municipal local model, knowledge is influenced mainly by theory and information, with 49.5% of the variance in knowledge explained by learning theory. Knowledge has a strong influence on all three belief constructs, however only perceived behavioural control has a significant influence on both intention and behaviour. Perceived behavioural control has twice the influence on behaviour as that of intention. Only 47.8% of the variance in behaviour in the municipal local model can be explained by the combined theoretical framework. For the private local model, knowledge is influenced mainly by experience, with 77.9% of the variance in knowledge explained by learning theory. Knowledge has a strong influence on all three belief constructs, however only attitude and subjective norms have an influence on intention. Perceived behavioural control has a direct influence on behaviour, more than twice the influence on behaviour as that of intention. Only 57.6% of the variance in behaviour in the private local model can be explained by the combined theoretical framework. The main findings of the statistical analysis are supported by the qualitative data. Content analysis shows that 67.7% of all responses to the open question on means of learning, favour experience, 25.8% theory and 6.5% data/information.

While good waste management practice is generally supported by all respondents, attitudinal differences are apparent between municipal and private respondents. Respondents from private organisations appear to be more concerned, and under greater pressure, to ensure legal compliance of waste operations. This compliance discourse within the private waste sector creates a strong organisational culture towards implementing good waste management practice, which is also evident in the normative beliefs of respondents in this sector. Subjective norms are referred to in the literature as having the weakest influence on behavioural intention, and this is evident in both the global and local models. Differences in normative beliefs are also evident in responses from municipal respondents, with some feeling that there is no organisational pressure to implement good waste management practice and others reporting that while Council and senior management expect good waste management practice to be implemented, they are given neither the resources nor the authority to do so. This is different to what we see in private organisations where there is a strong organisational culture to implement good waste management practice driven from the highest levels of management. This organisational culture in private organisations is driven by a strong compliance discourse, maintaining organisational environmental rating systems and public image, and in supporting business sustainability and profitability.

Results show a weak relationship between intention and behaviour, with perceived behavioural control having a greater effect on waste behaviour than intention. As volitional control decreases, so the translation of intention to behaviour decreases and perceived behavioural control plays a more fundamental role in predicting behaviour. The results suggest that good waste management practice is not under the volitional control of those tasked with its implementation. While intention and perceived behavioural control show a reasonable correlation with behaviour, they account for only around a half of actual waste management behaviour (53.7%), suggesting that there must be significant additional influences on behaviour that are not accounted for in this theoretical framework. These additional influences on behaviour, which might lie outside the theoretical framework, should be explored through further research.

It is recognised that the relative weights of beliefs vary from one person to another and across behaviours and situations (Ajzen, 1985; Ajzen, 1991), however results show that there are significant differences at the organisational level in the way the two sub-populations build knowledge, and construct intentions and behaviour, given the same target behaviour and situation. According to Ajzen (1991:206) “*it is at the level of beliefs that we can learn about the unique factors that induce one person to engage in the behaviour of interest and to prompt another to follow a different course of action*”. The results raise questions as to the nature of

these forces that appear to collectively shape personal beliefs and cause structural differences between public and private organisations. Similarly, it raises questions as to the apparent lack of volitional control of those tasked with the management of waste, particularly respondents in public organisations in South Africa. These questions need to be further explored.

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CHAPTER 6: BARRIERS TO ACTION

“CAUGHT BETWEEN THE GLOBAL ECONOMY AND LOCAL BUREAUCRACY: THE BARRIERS TO GOOD WASTE MANAGEMENT PRACTICE IN SOUTH AFRICA”

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6.1. Abstract

Empirical research shows that good waste management practice in South Africa is not always under the volitional control of those tasked with its implementation. The results also show that there are significant influences on waste behaviour, not accounted for by the theoretical framework, a combined process of learning and theory of planned behaviour. While intention to act may exist, external factors, within the distal and proximal context, create barriers to waste behaviour. In addition, these barriers differ for respondents in municipalities, private industry and private waste companies. This suggests that respondents in public and private waste organisations are subject to different structural forces that shape, enable and constrain waste behaviour. The main barriers to implementing good waste management practice experienced by respondents in municipalities include: insufficient funding for waste management and resultant lack of resources; insufficient waste knowledge; political interference in decision-making in the municipality; a slow decision-making process; lack of perceived authority to act by waste staff; and a low priority afforded to waste. Barriers experienced by respondents in private industry include: insufficient funding for waste and resultant lack of resources; insufficient waste knowledge; and government bureaucracy. The majority of respondents in private waste companies did not experience barriers to action. However, where barriers were experienced, these included: increasing costs; government bureaucracy; global markets; and availability of waste for recycling.

Keywords: Waste behaviour, barriers, situational factors, structure, agency

6.2. Introduction

The South African waste information system (SAWIS) provides an opportunity to explore whether the collection of data for a national waste information system can change the way waste is managed, such that there is a noticeable improvement. An empirical study conducted in 2006 (Godfrey & Scott, 2011) showed that there were organisations, typically private waste companies, that had been successful in collecting waste data for SAWIS and through assimilation and interpretation, utilising this waste information to inform and manage their operations. However, it was found that this collection and utilisation of data was not prompted by SAWIS, but rather for business reasons, including financial management, e.g. cost recovery (client billing); reduction of operational costs within waste facilities; or to support environmental reporting obligations, e.g. ISO14000, particularly where the company had an international parent company. There were also organisations that did not use the waste data after having collected it for SAWIS, and did not see the usefulness in the data. This resulted in no or little noticeable impact on operations, particularly within municipal waste facilities. It was also found that while the desire may exist within individuals to implement change based on a raised awareness in response to the data, situational factors, such as organisational bureaucracy and administrative procedures, made it difficult for them to implement the necessary changes. These external constraints on behaviour were more noticeable within public waste organisations than within private organisations (Godfrey & Scott, 2011).

A second empirical study was conducted in 2011, building onto the earlier research of 2006. Two linear action theories, the process of learning (Miller & Morris, 1999) and the theory of planned behaviour (Ajzen, 1985, 1991) were combined into a single theoretical framework that was used to examine the relationship between waste data and behaviour. The results of the research (Godfrey *et al.*, forthcoming 2012a, b) show that data has no significant direct influence on waste behaviour. While collecting waste data does have a positive impact on the way organisations manage their waste, it is not the data that produces the operational response. Instead, data, together with theory and experience build new waste knowledge, which does have a direct influence on waste behaviour. Of the three antecedents to knowledge (data, theory, experience), experience is shown to have the greatest influence on building waste knowledge in this case study (**Figure 6-1**).

Knowledge has a significant influence on all three of the antecedents to intention – attitude, subjective norm, and perceived behavioural control. While attitudes towards implementing good waste management practice are positive, and mixed results exist regarding social pressure to do so, it is perceived behavioural control (capability and controllability) that has the greatest

influence on both intention and waste behaviour in this case study (Godfrey *et al.*, forthcoming 2012b) (**Figure 6-1**). Experience, knowledge, and perceived behavioural control (PBC) are the three most significant influences on the current waste behaviour of interviewed respondents. In addition, intention to implement good waste management practice does not always manifest as actual behaviour (**Figure 6-1**), suggesting that good waste management practice is not always under the volitional control of those tasked with its implementation (Godfrey *et al.*, forthcoming 2012b).

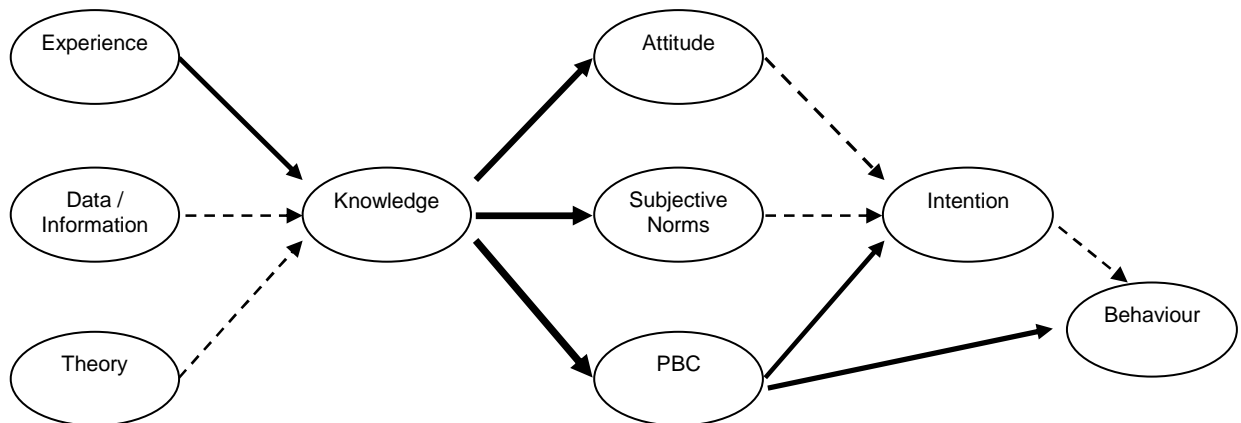


Figure 6-1. Path diagram for the global model (from Godfrey *et al.*, forthcoming 2012b)

*) Line weight is proportional to effect-size and to the degree of confidence in the link; broken lines indicate no influence. Line weight for unbroken paths is proportional to the lower bound of the associated confidence interval.

The research also shows that there are two sub-populations in the data set, namely respondents from public and private organisations, which are subject to different influences, impulses, and behaviours. While the structural/theoretical model is the same for the two parts, knowledge, intention, and behaviour are constructed differently for the sub-groups as shown in the local models (**Figures 6-2 and 6-3**) (Godfrey *et al.*, forthcoming 2012b). For each of the local models, differences are also evident in the percentage variance in behaviour that can be explained. The theoretical framework accounts for only 47.8% of the variance in behaviour in the municipal model and 57.6% of the variance in behaviour in the private model (Godfrey *et al.*, forthcoming 2012b). This suggests that there are significant factors in both municipalities and private companies, and perhaps more so in municipalities, that have a direct influence on behaviour, not explained by the theoretical framework.

6.3. Aim of the study

The aim of this study is to explore two important conclusions of Godfrey *et al.* (forthcoming

2012b). First, that there are obstacles that hinder the translation of intention into behaviour, which suggests that good waste management practice is not under the volitional control of those tasked with its implementation. Second, that there are significant differences in the way knowledge and behaviour are constructed for respondents in public and private waste organisations, and in the variance in waste behaviour explained by the local models. This suggests that there are underlying social forces that shape waste behaviour and that these forces may be different in public and private waste organisations.

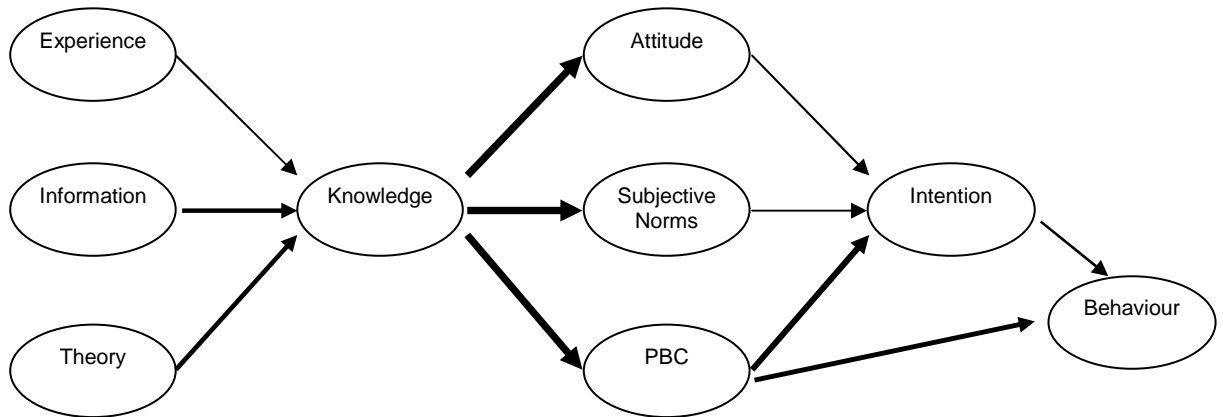


Figure 6-2. Path diagram for the *Municipal* local model (from Godfrey *et al.*, forthcoming 2012b)

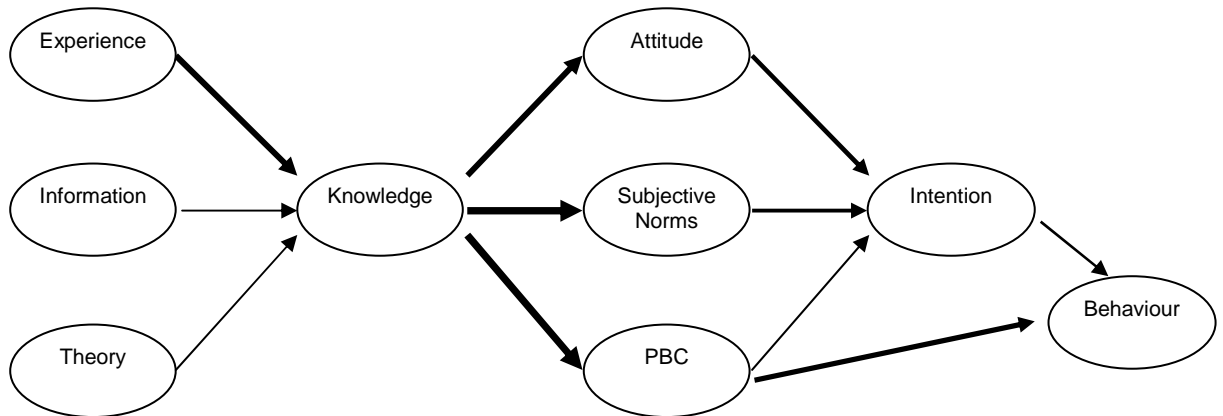


Figure 6-3. Path diagram for the *Private* local model (from Godfrey *et al.*, forthcoming 2012b)

*) Line weight is proportional to effect-size. The structural model (Figure 1) is able to depict construct relationships with no influence (broken lines). Due to the small sub-population this is not possible for the local models

A major critique of the theory of planned behaviour is this lack of variance in both intention and behaviour that can be explained by the model (Ogden, 2003; Munro *et al.*, 2007). While the

theory of planned behaviour is recognised as being one of the most influential attitude-behaviour models (Armitage & Conner, 2001; Kollmuss & Agyeman, 2002), it has been widely criticised for a number of shortcomings. As a social-cognitive theory, the theory of planned behaviour has been criticised for encompassing only the conscious and rational influences on behaviour, and for assuming that an individual's behaviour is controlled and planned (Pfeffer & Sutton 2000; Armitage & Conner, 2001; Kollmuss & Agyeman, 2002; Munro *et al.*, 2007; Chen & Chen, 2011; Norman, 2011). It is also considered too atomistic, focusing solely on the individual decision-maker, with little account for the context in which behaviour is influenced by social norms (Abraham *et al.*, 1998; Stern, 2000; Lucas *et al.*, 2008). The validity of this theory in the context of a developing country has also been brought into question; a context in which factors external to the individual are considered highly relevant. (Eaton *et al.*, 2003).

Within the context of the theory of planned behaviour, external factors are said to influence intention and behaviour indirectly by shaping behavioural, normative and control beliefs (Ajzen & Fishbein, 1980, 2005). According to Ajzen (1991:206) "*it is at the level of beliefs that we can learn about the unique factors that induce one person to engage in the behaviour of interest and to prompt another to follow a different course of action*". While Stern *et al.* (1995:726) recognise that external factors influence beliefs they also recognise that individuals are "*embedded in a social structure that has a substantial influence on all psychological variables*". These social structures act in two ways, by shaping an individual's general beliefs or worldview, as put forward by Ajzen (1980), and also by providing opportunities and constraints that support or hinder behaviour. In fact, Stern *et al.* (1995) criticises the theory of planned behaviour for not adequately considering the relationship between beliefs and the effects of the social and institutional context. According to Stern *et al.* (1995) there appears to be little empirical research specifically on the influence of behavioural context on behaviour.

Theorists recognise that actors are deeply embedded within social structures that shape behaviour. If we accept this position of Ajzen (1980, 2005) and Stern *et al.* (1995) to be correct, the first question the authors ask is "*What are the underlying structural forces that exert an influence on public and private waste organisations and that shape the behaviour of those tasked with the implementation of good waste management practice?*" While respondents may hold strong intentions to implement good waste management practice, there is evidence of a weak translation of intention into behaviour, suggesting a lack of volitional control over the target behaviour. There are also differences in the translation of intention into behaviour between organisation types. The second question the authors ask is "*What factors support or inhibit waste behaviour, such that intention is not translated into behaviour?*" To answer the first question, we must first answer the second. By exploring the obstacles to good waste

management practice we start to gain insight into the underlying social, economic and political structures that shape agency in South African waste organisations.

Eaton *et al.* (2003) provide a useful framework for organising the discussion around behaviour and context (**Figure 6-4**) by acknowledging both the subjective and objective influences on behaviour. The framework recognises proximal and distal contexts which influence behaviour. The proximal context represents interpersonal relations and the physical and organisational environment in which behaviour takes place. The distal context includes the structural forces in society which influence behaviour, including the legal, political, economic and organisational elements of society (Eaton *et al.*, 2003).

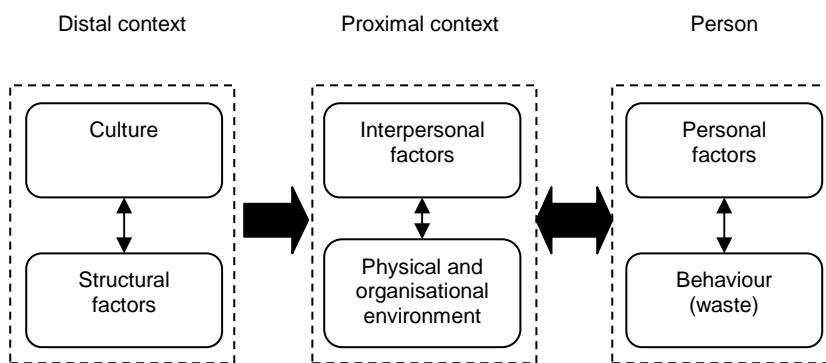


Figure 6-4. Framework for organizing the relationship between waste behaviour and the proximal and distal societal contexts (adapted from Eaton *et al.*, 2003).

In order to deal with the two research questions in sufficient detail, the results are presented in two papers. This paper, the first of two, focuses on important obstacles to good waste management practice identified by respondents, within the proximal context. The second paper (Godfrey *et al.*, forthcoming 2012c) focuses on the underlying structural forces, within the distal context, that shape waste management in South Africa.

It must be emphasised that the purpose of this research is not to identify all obstacles facing waste management in South Africa. Similarly, it is not the intention of the authors to examine empirical relationships between situational factors and behaviour, as have been done by others (Barr, 2007; Perry & Williams, 2007; Nixon & Saphores, 2009). Instead, the aim of this paper is to better understand the obstacles to good waste management practice, in the context of data and waste behaviour in South Africa, so as to identify future areas of intervention.

6.4. Situational factors as opportunity or constraint to action

Barriers to action are often collectively referred to in the literature as ‘situational factors’. These factors are external to the cognitive, decision-making processes outlined in social-cognitive models such as the theory of planned behaviour (Dommermuth *et al.*, 2011). The influence of situational factors that either enable or constrain behaviour or human agency (de Man, 2006; Binder, 2007), has received little attention in environmental research (Oom Do Valle *et al.*, 2005; Tudor *et al.*, 2008) and even less in waste research. In addition, since most waste behaviour research has focussed on waste recycling at household level (Oom Do Valle *et al.*, 2005; Barr, 2007; Kurz *et al.*, 2007; Mosler *et al.*, 2008), the situational factors that have been shown to influence behaviour have largely focussed on three types – socio-demographic factors, behavioural context, and psychological factors. These factors exist within the personal and proximal contexts of the individual (**Figure 6-4**).

Socio-demographic factors include age, gender, race, education levels and social class (Kollmuss & Agyeman, 2002; Ajzen & Fishbein, 2005; Barr, 2007; Kurz *et al.*, 2007; Chung & Leung, 2007), while behavioural context (Barr, 2007) includes the availability and proximity of recycling equipment and infrastructure (Barr, 2007; Knussen & Yule, 2008; Mosler *et al.*, 2008). Psychological or personality factors such as personality, mood, emotion, general attitudes and values, intelligence, group membership, past experiences, exposure to information, social support, and coping skills are a third type of situational factor influencing behaviour and in particular waste recycling behaviour (Ajzen & Fishbein, 2005; Barr, 2007). This paper focuses mainly on the barriers to waste behaviour at the proximal context, which manifest at the organisational level.

6.5. Method

6.5.1. Participants

Research participants were limited to those organisations that had submitted data to the SAWIS in 2009 and 2010, a total of 40 organisations (14 municipal, 26 private). Because of the small population size, sampling was felt to be unnecessary and all organisations were approached to participate in the research. Respondents were identified within each of the participating organisations as the registered system user or person responsible for capturing and submitting the waste data to SAWIS. Of the 40 participating organisations, two organisations were no longer contactable and seven organisations did not participate in the study. In certain organisations the responsibility for capturing the data, and uploading the data, has been split

between different persons. In these cases, both persons were approached for interviews. From the 31 available organisations, 44 respondents participated in the study (15 municipal, 29 private).

6.5.2. The target behaviour

For the purposes of this research, and to maintain the principle of compatibility (Francis *et al.*, 2004), the behaviour under investigation is defined as ‘good waste management practice’; in the day-to-day handling of waste; at facilities owned or operated by public and private waste organisations; within South Africa. Good waste management practice is defined for the purposes of this research as “*waste activities that are compliant with waste and environmental legislation; that promote the waste hierarchy and support waste avoidance, minimisation, reuse, and recycling; and that minimise the impact of waste and possible associated pollution on the environment and human health*” (Godfrey *et al.*, forthcoming 2012b).

6.5.3. Research design

The research is located within a pragmatic paradigm and adopts a mixed-method research approach, combining both quantitative and qualitative research methods in support of the research question and purpose (Gelo *et al.*, 2008; Henning, 2009; Teddlie & Tashakkori, 2009). Data was collected by means of semi-structured interviews (n=44), each lasting approximately one hour. During the interviews, a questionnaire was administered. The questionnaire consisted of two parts, Part I being a self-completed questionnaire of 57 closed questions, and Part II being an interview schedule of 11 open questions which was administered by the lead researcher to guide the discussion. This paper focuses specifically on three open questions, aimed at understanding the barriers to good waste management practice in South Africa. These are: “*In your experience what are the top three barriers within your organisation to implementing good waste management practices?*”; “*Can you give an example, from your own experience, of one of these barriers that stopped you from implementing good waste management practices in your organisation?*”; and “*To what extent do you think that these barriers apply in other municipalities or private waste companies?*”.

This paper presents the results of the analysis of the qualitative data which emerged from the open discussion with respondents. Godfrey *et al.* (forthcoming 2012b) showed that knowledge and behaviour are constructed differently for respondents in different organisation types. These organisational sub-populations, i.e. public and private waste organisations, were retained in the analysis of the main barriers to behaviour.

Data analysis involved an interpretive approach, whereby a large body of interview transcript data was sorted and categorized into a small set of pertinent themes (Leedy and Ormond, 2005). Content analysis (Henning, 2009) was applied in interpreting the data, which allowed the authors to delve into the meaning, views and beliefs of respondents with regards to the management of waste in South Africa. The results are presented largely as a narrative of the main barriers to implementing good waste management practice in South Africa, as identified by respondents. These narratives explain the broad patterns of meaning found in the data and the differences between organisational types. The narratives are supported by statistical data obtained from the completed questionnaires. Respondents were asked on the questionnaires to rate their response to given statements on a seven point semantic differential scale, ranging from 1 to 7 (strongly disagree/strongly agree). Respondents scores were captured in a spreadsheet and used to compute basic descriptive statistics which are also presented in the following sections.

6.6. Results

From the analysis of the qualitative and quantitative data, there was a strong sense that respondents in municipalities experience greater barriers to implementing good waste management practice than respondents in private waste organisations. While barriers were identified within the private sector, there was a greater sense that these barriers were solvable, as indicated by Respondent 38 from a private waste company:

“There aren't really any [barriers], as far as I can see. Assets, other resources required, we can throw money at it and we resolve it. I don't see any barriers to any organisation to implement good waste management practices. If the commitment is there from the organisation to implement good waste management practices, there should be no barriers.”

The quantitative data indicates that respondents in municipalities perceive greater barriers to implementing good waste management practices, than respondents in private companies. Respondents from private waste companies, on average, disagree that there are barriers to implementing good waste management practice. On a scale of one to seven (strongly disagree/agree), municipal respondents reported a higher mean score of agreement to perceived barriers ($\bar{x} = 4.86$; $SD = 1.56$), than private industry respondents ($\bar{x} = 3.30$; $SD = 2.00$) and private waste company respondents ($\bar{x} = 2.71$; $SD = 2.02$).

The main barriers to implementing good waste management practice (in decreasing order of prominence) experienced by respondents in municipalities, private industry and private waste

companies are provided in **Table 6-1**. It is evident that while some problems are unique to organisational type, there is also overlap of barriers.

Table 6-1. The main barriers to implementing good waste management practice

Municipal	Private industry	Private waste
1. Insufficient funding for waste management and resultant lack of resources (including equipment and personnel)	1. Insufficient funding for waste and resultant lack of resources (including equipment and personnel)	1. Increasing costs of doing business
2. Insufficient waste knowledge at various levels within the organisation *)	2. Insufficient waste knowledge at various levels within the organisation *)	2. Government bureaucracy
3. Political interference in decision-making in the municipality	3. Government bureaucracy to managing waste	3. Global markets
4. Compounded by a slow decision-making process		4. Availability of waste for recycling
5. Lack of perceived authority to act by waste staff		
6. A low priority afforded to waste		

*) While knowledge is identified by both municipal and private industry as a barrier, a discussion on waste knowledge is not repeated here. See Godfrey et al. (forthcoming 2012a) for a more detailed discussion on knowledge as an inhibitor to behaviour.

While the following narratives focus on the top two or three barriers per organisation type, it is evident that the barriers are very closely interrelated with the result that one narrative addresses other issues raised by respondents. These stories aim to highlight that while respondents may be willing to implement good waste management practice, they are embedded within larger societal structures and institutional contexts that shape, enhance or inhibit their actions.

6.6.1. Obstacles to good waste management practice in municipalities

6.6.1.1. *The narrative of insufficient funding for waste service delivery in municipalities*

The first dominant narrative that emerged from interviews with municipal respondents is the lack of funding to manage waste in municipalities. Every municipal respondent interviewed noted insufficient funds as a barrier to implementing good waste management practice, with 71.4% of respondents citing funding as one of their two main barriers in the municipality. This lack of funding allocated to waste is ascribed to a number of issues as listed in **Table 6-2**. Selected issues are expanded on here, using the stories told by respondents.

Table 6-2. Reasons given by respondents for lack of funding in municipalities

1. High resident unemployment rates and delays in payment of indigent grants by National Treasury to the municipality	(Respondent 12, 26)
2. Rising municipal salary costs leaving very little funding for waste operations	(Respondent 1, 18, 28)
3. Waste being a low priority in municipalities	(Respondent 1, 6, 9, 13, 14, 26)
4. Difficulty in raising revenue due to the low tax base in the municipality	(Respondent 1, 14)
5. Poor cost recovery due to no, or a poor, billing system	(Respondent 1, 9)
6. Municipal spending on inappropriate projects	(Respondent 15)
7. Municipal budget cuts following the 2010 Soccer World Cup	(Respondent 6, 18, 19)
8. Reallocation of funding from waste budgets to cover shortfalls in other municipal line items	(Respondent 6, 9)

Indigents are defined by the South African government as anyone who does not have access to sufficient water, basic sanitation, refuse removal in denser settlements, environmental health, basic energy, health care, housing, and food and clothing (DPLG, 2005). Where municipalities have a high number of indigents, the municipality is eligible to apply for an indigent grant from the National Treasury Department to support municipalities in the provision of services. However, the following story highlights how delays in payment of this grant by Treasury to municipalities results in the funding being allocated by the municipality to those expenses where non-payment of accounts has resulted in legal action, rather than to where the funding was intended, such as waste management:

“There is a problem with money, definitely, we don't [have sufficient]. What we receive from the community is little as opposed to what we give to the community. We experience a lot of unemployment in our area, most of the people are indigent. And the [indigent] grant from National Treasury takes too long before it's paid to the municipality. Sometimes when it comes we owe a lot of money... your [electricity] and other commodities that we need as a municipality. That's where you experience a problem. [Waste] is not really low [priority] but you see when you arrive at that point you say 'these guys, some of them are taking us to court, so let's try to close the gaps on litigation' ” (Respondent 12).

Salaries of municipal officials have risen steeply over the past few years, with municipal salaries suggested to be 60-80% higher than that paid in the private sector. This has been used as a mechanism to retain staff in local government. Furthermore, the effectiveness of municipal unions has ensured that municipal staff are relatively well paid:

“In terms of staff, our internal municipal employees cost, it runs at around \$9.70⁷ per person per hour. In terms of the sectoral [wage] set by the Department of Labour for contract workers, it's around \$1.43, \$2.14 per hour. The rate we pay our internal labourers, it's more expensive [than the private sector]. So it gives us a saving of around 60% on labour cost [for contract labour]” (Respondent 28).

“[Private contractor] labour component, their bargaining council, is paying much less in salaries. [The municipal workers] are very, very highly paid, our labourers are getting, cost to council \$1,000 a month. Private contractor is a fifth part, so there's an 80% saving on salaries” (Respondent 1).

The result of these high labour costs in municipalities is that it leaves very little remaining municipal budget to pay for operational and capital expenditure to render waste services. Municipal representatives state that:

“We're just getting money to pay salaries. We can do nothing, no projects, no money. But if you see now it's another senior manager, another person being appointed” (Respondent 6).

“Salaries [in municipalities] will rise way above the National Treasury norm of increases, so the only place you can cut is on your maintenance side. And that's actually where you need it the most. So eventually you run your trucks into the ground because you can't purchase new trucks and so forth. So eventually it becomes a huge problem” (Respondent 18).

Economists have warned that the state wage bill is unsustainable, with public sector wages standing at around 40% of non-interest consolidated expenditure, leaving only 60% for the provision of services. In addition, while the South African private sector has shed 91,000 jobs in 2010/11 (and continues to shed jobs in response to the recession), the public sector has continued to employ people, placing a greater strain on municipal budgets (Steyn, 2011).

This high allocation of budgets to salaries is problematic when current municipal waste equipment is old (often older than 20 years), vehicle breakages high and repairs by municipal workshops are slow and costly (Respondent 10, 12, 14). As pointed out by a municipal waste official: *“When it comes to capital items, [Council] are not very eager to spend a lot of money on vehicles” (Respondent 14).* The result is that waste officials find that they are constrained in terms of available budget, and what budget they do have, is typically not approved for capital expenditure (Respondents 13, 14, 15, 28). This makes operating specialised waste collection

⁷ All amounts are given in US\$, converted from South African ZAR at a rate of ZAR7:US\$1

vehicles and sanitary landfill sites difficult, since high operational and capital costs are incurred. As highlighted in the following paragraphs, certain municipal waste officials have found a way around the barrier of municipalities not being able to spend money on capital equipment, by either renting equipment or by outsourcing waste operations.

Renting waste collection and landfill equipment, as opposed to purchasing it, is an example of how capital expenditure can be operationalised within the municipal budget:

“Sometimes you find there’s no money available to get all the necessary machinery that you need, because council doesn’t have money. So we rely on hiring. From my side it’s cheaper to hire [the equipment]. If you check which one is the best, I’d say [hiring] has got no headache, you’ll get the best service hiring the machinery. If they’re broken they’ll be repaired and there’s no stress. But council, the machine will stand there, but the moment they fix it, it will come with a bill of a lot of money, which will run only for two days a week and is broken again” (Respondent 9).

Outsourcing waste operations to private waste contractors is another example of how municipalities “operationalise [their] capital expenditure” (Respondent 28):

“A contractor it’s a tender, it’s there, it’s budgeted for. If it was us [the municipality], if we’re saying we want this and that, they would not take it serious, it’s an internal thing, we’ll sort it out. But now, if it’s a contractor, it’s a contract, it’s binding, so they comply” (Respondent 13).

Between the 2006 interviews (Godfrey & Scott, 2011) and the 2011 interviews, it is evident that a growing number of municipalities are now outsourcing their waste operations. Of the municipalities currently reporting to SAWIS, 67% have now contracted out the operation of their landfills to private waste companies, which includes their requirements for waste data collection. Respondents indicate that outsourcing of waste operations to private contractors results in direct cost savings to the municipality (Respondent 9, 15, 26, 28); access to better waste equipment and technical waste knowledge in the municipality (Respondent 15, 28); faster procurement processes (Respondent 28); and to overall improved waste operations and legislative compliance (Respondent 6, 13, 14, 28).

Contracting out allows respondents to overcome internal “red-tape” and slow municipal procurement processes. A municipal respondent described their procurement process as follows:

“The procurement process makes it difficult to run landfill sites following the Municipal Finance Management Act dot by dot. For example, looking at the risk

factor, if the clutch plate breaks on a \$257,143 compactor unit which costs around \$4,286. It means in terms of our procurement process we need to advertise the repair of that clutch plate for 7 days on a notice board, wait for people to do submissions for 7 days. After the submissions we do an evaluation report. Then it gets submitted to the director for signature. From the director we send it to finance who generate an order. Then we've got to wait another 7 days for an order to be implemented by the service provider and the clutch plate will be maintained. It's around 28, 30 days, a month" (Respondent 28).

Evidence from municipal respondents shows that a municipality is able to ensure better compliance of waste operations when managing a private contractor, than when operating the landfill themselves. (Respondent 1, 13):

"I think private [waste companies] they comply most of the time based on maybe the fact that they're getting paid for what they're doing and they are properly being monitored. But if the municipality operates on its own, it's like they become a bit reluctant to comply, to make sure they've got enough resources. It's easier for a contractor, because we're sitting there as watchdogs. We're making sure he complies. But if it's ourselves, it's like we have to watch ourselves and at the same time comply" (Respondent 13).

The use of severe penalties by municipalities against private contractors for non-compliance may be one of the reasons for improved site operation (Respondent 1, 14, 28): *"Unlike you telling yourself you're not happy with the slopes. You tell the contractor 'I want that done by tomorrow or we'll implement penalty clauses' "* (Respondent 28).

While contracting out waste operations is reported to improve waste management in municipalities, unions are strongly opposed to the idea (Respondent 1, 15, 18):

"If you look at the last 2 years, there's been an increased trend from the biggest trade union against the privatisation of any services. It makes a hell of a lot of sense [to outsource]. If you look overseas, waste collection services is not a municipal function anymore. The responsibility lies with the municipality, but the operation thereof is done by external or private companies. So that to me makes a lot of sense. It's better [to outsource waste operations] because it doesn't mix politics with service delivery. Because it becomes more difficult for 'jobs for friends', you can actually get people who really know the job to perform the function" (Respondent 18).

Striking municipal union workers are also no longer an obstacle for waste management with private contractors in place:

“In terms of responsibility when people go on strike, if it’s in our case then the services stop. If it’s in terms of the contractor he must get alternatives to do the service. So no service, no payment. So it goes with risk transfer” (Respondent 28).

6.6.1.2. The ‘politics of waste service delivery’ narrative in municipalities

The second dominant narrative that emerged from the interviews with municipal respondents is the strong political involvement in waste management decision-making and service delivery. Political ‘interference’ (Respondents 1, 6, 15, 18) in municipal waste operations is seen by respondents to play out at a number of levels within the municipality, from the highest level of the council as a decision-making body of local government, through senior management, to procurement and all the way down to the general worker:

“This whole thing of taking things to committees to get approval and then to [the] mayoral [committee] and to try and convince the politicians that what we want to do is the correct thing to do. Because good waste management practice isn’t always in line with what [the politicians] want on the ground. So it’s trying to convince everyone that this is the correct thing to do and then only [to] get approval and do it. But sometimes by that time you’ve lost some of your initial strive of wanting to get it done. Then you give up halfway” (Respondent 19).

“It’s bad for politicians to be in a service delivery section like [waste]. Politics is running the whole thing. New councillors come in and most of the times they say ‘no that’s the previous councillors project, cancel it’. That’s what happens, they interfere” (Respondent 15).

In addition to the members of council who are politically appointed, the senior management positions within local government are also viewed by respondents as political appointments. These are the:

“Article 57 appointments - they are the municipal manager, chief financial officer and then the general manager for community services, technical services, corporate services ... and there’s now another one, there’s six of them. But the majority of your managers and senior managers are also political” (Respondent 6).

While Council and senior management hold the decision-making powers in local government, they are not seen by municipal staff to be knowledgeable on waste issues and therefore not make informed decisions: *“Our budget is controlled by them so some of them are not yet knowledgeable about waste. Because it seems politicians are not aware of what’s going on [with waste]”* (Respondent 2). The impact of uninformed decision-making is evident in this example by a municipal respondent: *“We budgeted \$257,143 for a compactor unit. When we*

got to Council for approval they cut the budget down to \$71,429” (Respondent 28). Unknown to Council, cutting a budget for a compactor unit to \$71,429, is the same as declining the request, since such a vehicle cannot be purchased for that amount of money. Another example from the same municipality is that of a Council decision not to buy new vehicles:

“[Last year] all the trucks were broken, some are 28, 30 years old. We couldn’t find parts, couldn’t find replacements, so the whole city came to a standstill. So we went around looking for quotations to hire equipment. For the past 6 months it cost us equal to the amount we paid for the purchase of 4 trucks. It has cost \$985,714 to hire and the purchase of the four trucks has cost us \$1,142,857” (Respondent 28).

Due to this apparent lack of technical knowledge, uninformed decisions by senior decision-makers in municipalities, while trying to save money, very often results in increased expenditure, or the incorrect expenditure, and *“so, these conflicts between politics and technical issues, becomes a huge problem”* (Respondent 18).

There is a sense among respondents that people at senior management level are appointed because of their political connections and not their technical ability to do the job.

“Before 1994 you had to specialise. If they appoint a manager in charge of the department, he must be qualified in that department. But there [are] political appointments on ordinary management levels, there [are] political appointments on secretary level. I mean our manager; he’s been suspended for corruption. Everybody wants to get his finger on the money. And they’re not appointing people who can do the job. They will rather appoint a non-competent person but who has the right political connections. They said it’s not necessary to have the knowledge, you must only be capable. In [a nearby town] they suspended the person from treasury and made him the waste manager in [that town]. From treasury, because he’s got political connections. He knows nothing [about waste]” (Respondent 6).

“Politically, they will not replace a vacancy with skilled people. They will not employ a person they will deploy a person. A government official is deployed, is working for the ruling party and a public servant is employed and that’s the difference. If you’re employed as a public servant you serve the public as a skilled, passionate guy and they don’t look at that now when they appoint some people” (Respondent 1).

Concern was raised by respondents that in spite of strict procurement processes in local government, technical contracts can still be manipulated and awarded to political connections: *“Supply chain management is normally populated by political appointments, guys who will make sure that the tender is being manipulated in a certain direction”* (Respondent 1).

“I heard that tenders are already being offered to you and you and you, by political structures. They want ‘their’ people to do it, and you can’t. [Waste] is a specialised job” (Respondent 6).

The influence of strong political connections is not only seen at the decision-making level of council or senior management but also at the level of the labourer working with waste on the ground:

“Here are some labourers, waste collectors that have got strong ANC connections with politicians. You can do nothing to them. That is the problem, there’s too much politics. It’s not the politicians; it’s staff that is involved in politics. Here are general workers that are higher up in the [ruling party] than some of the politicians and [the labourers] get [the politicians] back at the ANC structure meetings. Years back no municipal official would have been involved in politics. A councillor couldn’t even give me instructions to do something, he had to go through the town clerk⁸” (Respondent 6).

The interference of unions in municipal operations, through their political alliance with the ANC, as the ruling political party, is also highlighted. Unions are seen to have a very strong influence on how municipalities operate:

“Now you must understand that the political alliance between [the unions] in municipalities and the ruling party is so strong. Management normally is politically appointed; they won’t even THINK to oppose the union. For instance we’ve got two [waste collection] trucks in reserve, two RELs [Rear End Loaders], that’s my policy. I must have two trucks in reserve for those breakdowns. You know, once you get to the four, five year stage we get this metal fatigue business. [Management] said but there’s two trucks, it’s a waste. I said no, it’s not a waste. We don’t pick up RELs. There’s no guy that can rent out the REL here. So if the truck is standing for a week, there’s no refuse removal, there’s no service delivery. So management is sort of deciding and you’ve got a hell of a battle to convince them. Even if they buy your story they will just decide with the union” (Respondent 1).

This sense that *“You can’t fight against the politics”* (Respondent 6), directly affects the motivation of some municipal respondents to implement good waste management practice.

6.6.1.3. The narrative of the “disempowered waste official”

The lack of power and authority to implement good waste management practice is the third

⁸ The town clerk during the former system of urban governance is equivalent of the municipal manager in the current system in South Africa.

dominant narrative evident from the interviews with municipal respondents. With decision-making resting with the municipal council and senior management, it means that those who have the responsibility to manage waste and implement good waste management practices, i.e. the waste officials, do not have the authority to do so (Respondent 6, 9, 15, 28).

“We don't have the authority, it has to go through Council. So you cannot decide that's what you want to implement. It has to go a route to get it implemented, it could take 6 months to a year” (Respondent 15).

“My permit condition [states] that this [landfill] must be fenced. I submitted my proposal for [a fence around the landfill], it needs to go via the city manager. It's been there from last year September when I started with our new budgets, it's still lying there... seven months later” (Respondent 9).

Waste officials feel that *“if you give a person [the budget], you must give him the authority to take decisions. You know, you can motivate and put everything there, but come the final approval [by council] they just go and cut.”* (Respondent 9). However, where respondents have some decision-making opportunities, they are often fearful of taking decisions because of internal politics.

“If you take the wrong decision you can end up on the street. They won't think twice to put you on suspension. So the people are so scared to take a decision. Rather leave it and don't make a right decision or a wrong decision. But we take the risk” (Respondent 15).

The lack of perceived authority also extends to respondents' control over their waste budgets:

“Sometimes you'll see your budget will be there, tomorrow they will just enter and remove money then you're sitting with no money. The city manager has got the right, if they see they've got a gap somewhere and there's money available they just go all through the votes and then when you come there you see the money has just been moved. Sometimes you feel you lose interest in terms of initiatives, it's frustrating” (Respondent 9).

“You know what happened last month. While I've still got money on my budget, we want to do something ... shooo, they just took it away. They just took it away and rescheduled it for the rest of the municipality. Our treasury department just takes that money and redistributes it to other departments. What must you do now?” (Respondent 6).

According to Respondent 4, *“implementing good waste management practice is a function of how high you are in the organisation, it's not a function of the amount of knowledge that you*

have.” It could be argued that the longer a person works in an organisation, the more they begin to understand the internal systems, and feel more in control of their actions. In doing so, they would achieve greater status, giving them more power to act, which results in fewer perceived barriers. However, this relationship between knowledge, status and perception of barriers is not evident from statistical results for municipal respondents. There is no statistically significant correlation ($r = 0.051$, at the 10% level of significance), between years in the organisation and perceived barriers to act. The evidence shows that that long service and status do not reduce barriers to action for those municipal respondents interviewed.

6.6.2. Obstacles to good waste management practice in private industry

6.6.2.1. *The narrative of waste as industry's "grudge spend"*

The lack of funding to implement good waste management practice is the dominant narrative evident from the interviews with respondents from private industry. The need for generating maximum income, profit and return on investment is evident in the management of waste within private industry. For private industry, waste management is seen as an expense, an impact on the bottom line or a “grudge spend”. According to a private sector respondent: *“Everything we waste is lost money”* (Respondent 4). As a result, respondents tasked with the management of waste generated by private industry, feel that insufficient funds are allocated to implementing good waste management practice or certainly anything more than the minimum practice of waste to landfill. Private sector waste personnel explained this as follows:

“ We understand what waste means, it means loss of revenue and it means a bad impact on the society that you live in. Normally the barriers aren't strong. Where you run into a barrier, you run into something called money and when that barrier comes up, the barrier is absolutely solid” (Respondent 4).

“We have the support of top management, if I can prove to them that the money they're going to put in they're going to save. Obviously the bottom line is still the profits, money is still the bottom line. So whatever you want to do, definitely to weigh it up with the amount of ... let's say we're going to put a million in, but what's the benefit that we're going to get. So they won't indulge in every little whim of idea of let's put worms in, let's make it lovely. It will definitely be a business decision. But if we can motivate properly and we can show them the benefits they'll be behind [us]” (Respondent 16).

A strong business case for implementing good waste management practice within industry, with evidence of suitable return on investment, therefore needs to be made by respondents in private industry to gain access to funding.

Respondents from industry did express a frustration at not being able to implement waste projects as quickly as they would like to, given these financial constraints (Respondent 3, 4, 5). Expenditure for waste initiatives needs to be budgeted for and processes followed, with the result that projects may only be implemented within the next budget cycle:

“We might have a commitment [from senior management] towards something but it's not always possible to fulfil that commitment because of resource constraints. We can't do things as fast as we'd like to do them. So you have to budget and something that you'd like to see happen immediately will take a few years because of capital constraints. It takes longer than I as an environmentalist would like to see it happen. This is a business, so we have to work within those constraints. Sometimes the market climate doesn't allow us to do the things we want to do, even though we want to” (Respondent 3).

In private industry, unlike in municipalities, there is a higher level of commitment from senior management in seeing waste projects implemented, so while projects may not necessarily happen in the current financial year, they will happen. Respondent 5 pointed out that *“Although it will take some time, maybe I'll have to wait for the next year's budget, but I will get it.”* What we see in industry supports the position of Ajzen (1985) who sees these situational factors of time, opportunity and dependence on others, as only temporary disruptions or delays in agency rather than in changing personal beliefs. This is different to what we see in municipalities, where evidences shows that financial constraints are often not overcome, even when strong motivations are made. This often results in disillusionment of municipal staff and abandonment of waste projects (Respondent 9, 19).

Because of these financial constraints, anything more than the minimum form of waste management (e.g. disposal to landfill) is often not supported, particularly where additional costs will be incurred by the industry. However, respondents do feel that the introduction of stricter legislation will assist them in implementing new waste initiatives within industry:

“As the focus changes from government's side to focus strongly on certain issues, we start to put our resources behind those things, because it's been seen that we need to be legally compliant” (Respondent 3).

“If it's a legal problem, if it's hazardous waste that needs to be disposed of, then they tend to have no problem with it” (Respondent 17).

This strong legal compliance discourse, prevalent in the participating private waste organisations, is discussed in Godfrey *et al.* (forthcoming 2012b).

When industry is under financial pressure, expenditure needs to be based on maximum return on investment and this usually involves spending money on operations rather than waste management (Respondents 4, 8, 20).

“To implement new waste strategies generally results in money being spent and business is tight. So even when it comes to expenditure, there's always a fight for where's that money going to be spent where it's going to add the most value. When a business is marginal you try and spend it on your production processes to try and get your profitability up rather than spend it on systems that are going to facilitate better waste management.” (Respondent 20).

“It's quite difficult sometimes in companies trying to justify or motivate to get money to spend on environmental issues rather than trying to justify spending money on putting in additional equipment that could increase your capacity and hence your revenue from it” (Respondent 8).

“I came from an organisation where once I was told ‘we will not spend money on things that do not make money, period.’ And you can scream all you want” (Respondent 4).

The lack of funding for waste management in private industry is even more evident during the global economic recession, which hit South Africa in the first quarter of 2009 (Statistics South Africa, 2009).

“When things do get tough for companies out there, the first place they start looking to cut down, is in terms of your waste disposal and do you send stuff” (Respondent 8).

“In the year that the recession started, all environmental projects, well for that matter, every single project was immediately put on ice.” (Respondent 4)

“The cash flow had to be used to actually pay salaries. We could only do the bare minimum stuff, the legal compliance stuff” (Respondent 3).

6.6.2.2. *The “red tape” of managing waste in South Africa*

The second dominant narrative that emerged from interviews with respondents from private industry is the “red tape” or bureaucracy in implementing good waste management practice, and in particular in ensuring compliance. Government bureaucracy was also raised as the second dominant issue by private waste businesses, and so is discussed together.

South Africa has adopted a broad, protection based definition of waste (Oelofse & Godfrey, 2008), with the result that waste is managed under a bureaucracy of legal requirements, including environmental impact assessments, permits and licences. These legal requirements

are compounded by apparent dual enforcement standards between the public and private waste sectors (Respondent 22, 37) with strict enforcement applied only to the private waste sector (Bosman & Boyd, 2008; Engledow & Groeners, 2008). Godfrey (2008) showed that of the non-compliant unpermitted/unknown permit status landfill sites, in excess of 90% were municipal landfills, supporting the above findings.

While private sector respondents may want to implement good waste management practice, they are often constrained by facility permit conditions (Respondent 7, 8, 22, 38). While this in itself should not be a barrier to action, the very slow amendment to permit conditions or the issuing of new licences to allow such practices, has become a barrier. This is highlighted in the story by Respondent 22:

“Something that we’re trying to get going is to try and do some recycling. We’re not allowed to have any salvaging on site in terms of our permit. But there’s certain waste streams coming in which we could recycle. To try and get any permit conditions amended, you’re hitting a bureaucratic wall. And then you seem to be getting somewhere and then the person changes and then you have to start from scratch. I have permit amendments that I applied for which I feel would enable us to actually operate better in terms of the [waste] hierarchy, dating back to 2009. And because we haven’t had a response we are bound to carry on operating the way we are.”

This process of issuing of licences or permit amendments by Government is seen by respondents to be a very slow, bureaucratic process, with respondents reporting three to eight years to obtain a licence (Respondent 7, 8, 31, 32) and one to two years for a permit amendment to be approved (Respondent 29, 38).

“The [waste plant] was built and they did some test work to prove the performance in 2007 and since then, that machine has not run. We’ve never switched it on because we didn’t receive the licence. So until we receive the licence we can’t switch the machine on. So it’s been for the last 3 years, trying to get the licence” (Respondent 8).

This time consuming and costly bureaucratic exercise (Respondent 7, 20) is also often not seen by industry to add any value to waste operations.

“I’ve got a person almost working fulltime on just putting a whole lot of administrative data together so that we can licence an activity we’ve been doing for 40 years. And those kinds of things aren’t helpful, they’re not changing anything. It doesn’t change the quality of our recycling, it doesn’t change whether we’re

reducing or increasing our waste. We've now got to licence all the activities, it's costing us a PACKET of money with external consultants. I see absolutely no reason for it. It doesn't affect this business positively in any manner" (Respondent 20).

The strict auditing of private waste facilities *"to the letter of the permit conditions"* (Respondent 22, 38) means that companies are often very reluctant to proceed with new activities, even if they lead to an improvement in the way waste is managed. A respondent from a private waste company explained this as follows:

"In some cases yes [we go ahead without the permit amendment]. In some cases where I have the science and the backup and the benefit of being able to go out and say to a specialist in the field, 'what's your honest opinion' and I'll get a response in writing covering me, then I'll go ahead. In some cases it's a little bit more tricky, in which case we just don't do it, just simply because the risk is too high" (Respondent 38).

6.6.3. Obstacles to good waste management practice in private waste companies

6.6.3.1. Increasing costs of doing business in South Africa

The increasing cost of doing business in South Africa is the dominant narrative that emerged from interviews with respondents from private waste companies. Respondents point out that increasing local business costs such as electricity (Respondent 24, 25, 35), transport (Respondent 7, 21, 24, 25, 30, 38) and labour (Respondent 7, 24, 25) directly impact upon their ability to implement good waste management practices: *"Electricity's gone up 25%, it's going to go up now again. We worked out by 2013 we have to do an extra turnover of \$414,285 just to cover our electricity costs. It's frightening"* (Respondent 25). While the South African government has put systems in place to reduce this burden on business, such as tiered pricing scales, and peak and off-peak tariffs for electricity, these incentives are not always available to business, especially where electricity is sold on by the municipality and not directly by Eskom, the national energy supplier. A respondent from a small private industry reported on the concerns of their company:

"We've got a terrible situation with [the] municipality when it comes to industry. Obviously [the big industries] get helped, assisted, I'm sure, I'm just assuming... I don't know. In a case of them supplying us with electricity, now we run 24 hours a day and we run on weekends. We don't get a rebate on the weekend running. Whereas the Johannesburg guys and the guys that are on Eskom supplies all get a massive rebate for running on a Saturday or Sunday, or at night" (Respondent 24).

Even where different pricing systems for electricity do exist, the nature of the waste business is such that it cannot always take advantage of these reduced off-peak tariff incentives:

“Electricity has a massive impact. Especially in running a [recycling business like ours], we use a lot of electricity. So it impacts and we can see the jump in electricity cost. We track that, we monitor we try and save where we can. There is a tiered scale, you know, off-peak and peak, but we can't manage our business to fall into the off-peak period. I know some businesses can run flat out at night and scale down at peak periods. But we can't” (Respondent 35).

Increasing labour costs in private business, while apparently not as high as in the public sector (Respondent 1, 28), are impacting upon the cost of doing business, and in instances, on the feasibility of doing business at all. This issue is compounded by strained relationships between business and unions:

“We had a meeting today with the bargaining council and the union. They've got a certain [wage increase] rate we have to pay staff. They say 'you're not paying the full rate by 2013 we're going to start attaching your equipment'. They're actually telling us if you don't pay 100% of the bargaining council vote they'll actually close us. They'll rather put people out of employment than actually pay them less. I'll give you a scenario, there's a company here, they had a bit of a waste by-product. So they thought they'd make kitchen utensils. The union walked in and the bargaining council said 'ok you're not part of the union, this is the rate you have to pay'. The chap actually closed his business, he said he can't afford it. They're actually starting to close businesses now. If you haven't complied within 3 months the sheriff of the court will walk in and attach your equipment. But that's their logic, they'll take the machines away to pay the staff the difference, but now with the machines gone, what are the staff going to do. So if the labour court doesn't come to the party then they must do what they must do. We'll close and open a warehouse and we'll import from China. If we're not going to manufacture, why recycle.” (Respondent 25).

Closing such businesses means that significant tonnages of waste which are currently being recycled, will now return to landfill, which is not good waste management practice.

With increasing local business costs and increasing legal compliance demands, industry is being squeezed between expenditure on environmental compliance and weakening income in a global economy (Respondent 3).

6.6.3.2. *The narrative of 'doing business as part of a global market'*

As part of a global economy, the South African waste sector is subject to global market influences, which very often place constraints on intentions to implement good waste management practice. This is particularly evident in the South African paper, plastic and waste oil recycling industries, where companies are competing with international prices of virgin materials and cheaper imports, as shown in the narratives below. The following two examples from respondents in the waste recycling sector show how international market fluctuations impact upon local business and the ability of respondents to act.

The first example is where waste is competing against virgin material as input into manufacturing processes. Here industries have a choice between buying virgin material, e.g. oil, polymer and fibre, or buying reprocessed waste materials. This choice is usually driven by price, especially in the absence of government incentives, so if international prices of virgin material drop, industry will choose virgin material over reprocessed waste, directly impacting the local recycling industry. A respondent from private industry reported on the implications locally of these global processes:

“The last 2 years, 2009 and 2010 have been shocking, absolutely shocking, with the recession, and with the virgin polymer price. The virgin polymer price in 2008 dropped by 32% which meant that we had to drop [waste] prices and then we had this hefty 30% increase [in electricity], which is obviously our largest expense. We've just put prices up now for the first time since 2008” (Respondent 24).

The second example is where local industry, utilising waste materials in their manufacturing process, compete with imported final consumer products. If this consumer product can be imported into South Africa cheaper than it can be produced locally, it has a direct impact on the viability of local manufacturing businesses and as a result, the recycling of waste materials.

“We're competing on a global market at the moment and paper that lands in South Africa, lands here cheap, very cheap. The [paper recycling and manufacturing] industry is under significant pressure from Indonesia, Brazil, China and India. They bring in large quantities of paper and it's at the cost of production here or cheaper in many cases. I mean the pricing is ridiculous, you can't compete, up to 40% cheaper in some cases. You can't hold margins, you can't hold your volumes, you can't hold anything” (Respondent 20).

“If we didn't do recycling we'd be out of business today. Because we've got major, major hassles with imports. Imports are killing us, imported [product]. They can import the [product] from China and Korea, 30% cheaper than we can manufacture it [locally], although we're recycling. So we're just hoping for the exchange rate to

change and the Chinese to put legislation in place” (Respondent 25).

If imported goods become cheaper through weaker foreign environmental policy or weakening exchange rates, manufacturing businesses that reprocess waste are at risk of closing, which means that large quantities of waste suitable for recycling would be disposed of to landfill, in spite of intentions to implement good waste management practice. A local business under threat of cheaper plastic imports currently recycles 1,200 tonnes of waste polystyrene per annum, a considerable volume of waste that would be returned to landfill if the business closes. And with no support from government, increasing local costs make this a reality.

6.7. Conclusion

Barriers to implementing good waste management practice, within the context of SAWIS research, were first observed by Godfrey & Scott (2011) in the 2006 SAWIS case study. Research undertaken by Godfrey *et al.* (forthcoming 2012b) which explores the relationship between data and waste behaviour in a further study, shows that while data is important (although not significant) in building knowledge and resultant behavioural intention, this intention is not always translated into waste behaviour. The results suggest that good waste management practice is not always under the volitional control of those tasked with its implementation.

Analysis of the data in the latter study shows that respondents do feel the effect of external factors within the organisational environment; more so in municipalities than private waste companies. In addition, these barriers differ to some degree between municipalities, private industry and private waste companies, although some level of overlap is experienced. This suggests that respondents in organisations are subject to different societal forces that shape, enable and constrain waste behaviour. This paper has provided a deeper understanding of these barriers, which was made possible by applying a mixed-methods research design.

The main barriers to implementing good waste management practice experienced by respondents in *municipalities* included (in decreasing order of prominence) (1) insufficient funding for waste management and resultant lack of resources (including equipment and personnel); (2) insufficient waste knowledge at various levels within the organisation (Godfrey *et al.*, paper 4); (3) political interference in decision-making in the municipality; (4) a slow decision-making process; (5) lack of perceived authority to act by waste staff; and (6) a low priority afforded to waste. Barriers experienced by respondents in *private industry* included (in decreasing order of prominence) (1) insufficient funding for waste and the resultant lack of

resources (including equipment and personnel); (2) insufficient waste knowledge at various levels within the organisation (Godfrey *et al.*, paper 4); and (3) government bureaucracy. The majority of respondents in *private waste companies* noted that there were no real barriers to implementing good waste management practice. Where barriers were experienced, these included (in decreasing order of prominence) (1) increasing costs; (2) government bureaucracy; (3) global markets; (4) availability of waste for recycling.

These barriers, which manifest in the organisational environment in what is termed the proximal context, are thought to be the result of deeper societal structures enabling or constraining agency from within the distal context (Eaton *et al.*, 2003). By understanding these structural factors and their implications in the organisational environment, we are better able to place these barriers in context and identify improved measures to support respondents in implementing good waste management practice. These structural forces need to be explored through further research.

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CHAPTER 7: THE INFLUENCE OF SOCIETAL CONTEXT

“A CONCEPTUAL MODEL OF WASTE BEHAVIOUR: SITUATING WASTE MANAGEMENT WITHIN A BROADER SOCIETAL CONTEXT”

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7.1. Abstract

This paper presents a novel conceptual waste model of the knowledgeable, situated actor. Recent empirical studies have shown the importance of the individual in waste behaviour, in particular, in implementing good waste management practice in South Africa. However, for respondents in public and private waste organisations participating in the South African Waste Information System (SAWIS), the influence of societal context on individual behaviour is evident. The main social, economic, and political structures are discussed by drawing inferences from the barriers to good waste management practice, as experienced by respondents. These structures impact upon the ability of waste officers to implement good waste management practice, by shaping the underlying beliefs of individuals and ultimately their intentions and behaviours. However, the structures also create social and organisational barriers which constrain agency, often resulting in low volitional control. The evidence suggests a growing tension between political structures in a post-1994 transforming South Africa, and strong neoliberal economic structures, both of which are felt in the management of waste. While certain respondents have become disempowered as a result of these societal structures, others have found innovative ways of reclaiming agency. By identifying the societal structures and resultant barriers to good waste management practice, the authors have been able to situate waste management within the broader societal context in South Africa, providing a better understanding of waste behaviour.

Keywords: model, structure, agency, barriers, behaviour, waste information system

7.2. Introduction

The South African Waste Information System (SAWIS) has provided a unique case study over the past five years to explore the potential impact of waste data on waste behaviour in a developing country. Research was undertaken by Godfrey & Scott (2011) and Godfrey *et al.*, (forthcoming 2012a, b), to explore the influence of SAWIS waste data on the behaviour of waste officers in public and private waste organisations. While data was shown to currently have no significant direct or indirect effect on behaviour, the authors reached two important conclusions.

First, by applying a modified theory of planned behaviour to the data, the authors showed that while data does contribute to building knowledge and intention, this intention does not always translate into waste behaviour (Godfrey *et al.*, forthcoming 2012b). This suggests that good waste management practice⁹ is not always under the volitional control of those tasked with its implementation. The theoretical framework accounted for 53.7% of the variance in behaviour of respondents, suggesting significant external influences on behaviour not accounted for in the framework. External factors were reported by respondents to hinder agency; more so in municipalities than private waste companies.

Second, there are significant differences in the way waste knowledge and behaviour are constructed by respondents in public and private waste organisations. The theoretical framework accounted for 47.8% of the variance in behaviour of respondents in public waste organisations and 57.6% of the variance in behaviour of respondents in private waste organisations (Godfrey *et al.*, forthcoming 2012b). The types of barriers to good waste management practice were also shown to differ for respondents in different organisational types, *viz.*, municipalities, private industry and private waste companies (Godfrey *et al.*, forthcoming 2012c). The results suggest that there are external social forces that shape, enable and constrain individual behaviour, and that these forces may be different in public and private waste organisations.

The discrepancy between intention and waste behaviour found in the study of Godfrey *et al.*, (forthcoming 2012b), has been recognised in environmental behaviour studies as the ‘value-action gap’ (Stern, 2000; Jackson, 2005; Darnton *et al.*, 2006; Chung & Leung, 2007). Jackson (2005:vii) notes that individual attitudes and behaviours are embedded within social and

⁹ Good waste management practice is defined for the purposes of this research as: *waste activities that are compliant with waste and environmental legislation; that promote the waste hierarchy and support waste avoidance, minimisation, reuse, and recycling; and that minimise the impact of waste and possible associated pollution on the environment and human health.*

institutional contexts and that these contexts “*continually shape and constrain individual preference.*” Where contextual factors are weak, the relationship between attitude and behaviour is said to be at its strongest, whereas when contextual factors are strongly negative or positive, a weak relationship exists between attitude and behaviour (Stern, 2000; Jackson, 2005). According to Fudge & Peters (2011), the gap between context and behaviour is more significant than the gap between value and action, suggesting that context plays a more dominant role in shaping behaviour than beliefs.

The research on the influence of SAWIS waste data on behaviour has up until this point, focussed largely on the agency of actors in waste organisations (Godfrey & Scott, 2011; Godfrey *et al.*, forthcoming 2012a, b). Environmental behaviour research has been criticised for focussing too narrowly on the individual through atomistic, socio-cognitive theories that only consider factors internal to the individual; what Fudge & Peters (2011:806) refer to as an “*over-emphasis on the rational agency of individuals.*” With the result that these internal factors obscure the influence of external social, economic, and political factors (Shove, 2003; Jackson, 2005; Fudge & Peters, 2011). According to Shove (2003:1), environmental research has focused on “*an extraordinarily narrow understanding of human behaviour*”, typically overlooking the “*complex, social and cultural dimensions of agency*” (Fudge & Peters, 2011:796). While the research of Godfrey *et al.* (forthcoming, 2012b) recognises the concept of ‘individual agency’, the results suggest that a better understanding of waste behaviour can only be achieved by combining this traditional ‘*internalist*’ approach with an ‘*externalist*’ approach, which recognises the importance of factors external to the individual in shaping, enabling and constraining behaviour (Jackson, 2005). External factors are thought to occur at two levels, as organisational factors within the proximal context, and as deep, societal structural factors within the distal context (Eaton *et al.*, 2003) (**Figure 7-1**).

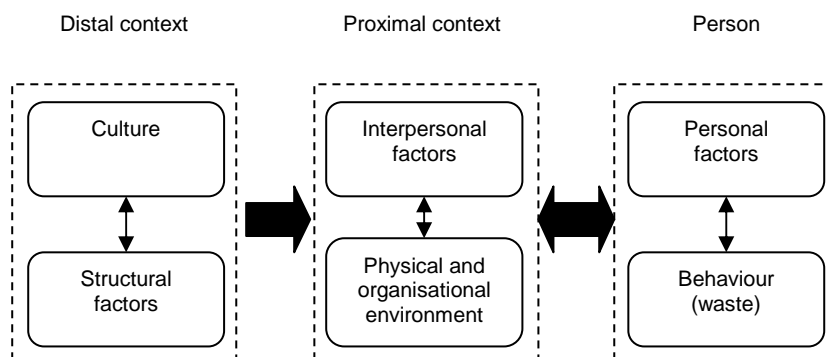


Figure 7-1. Framework for organizing the relationship between waste behaviour and the proximal and distal contexts (adapted from Eaton *et al.*, 2003).

The external factors, which act as barriers to waste behaviour at the organisational level, have been shown to be relevant to waste management in South Africa (Godfrey *et al.*, forthcoming 2012c). However, in independent studies, Godfrey and Oelofse (2008) showed that barriers to good waste management practice in South Africa are often symptoms of deeper-seated issues. Hart (forthcoming:32) found similar patterns within the South African water sector, where problems with local government were shown to be the result of “*deeper systemic tensions and contradictions.*”

7.3. Aim of the study

Based on the findings of Godfrey *et al.*, (forthcoming, 2012c) the authors posit that the societal context in South Africa directly shapes waste behaviour; shapes behaviour differently for individuals in public and private waste organisations; and shapes the translation of intention into waste behaviour. Recognising the influence of societal context, this paper further builds on the theoretical framework of Godfrey *et al.*, (forthcoming 2012b) to create a more conceptually inclusive framework that explains the earlier results of Godfrey & Scott (2011) and Godfrey *et al.* (forthcoming 2012a, b, c).

In order to deal with each of these conclusions of Godfrey *et al.*, (forthcoming 2012b) in sufficient detail, the results are presented in two papers. The first paper (Godfrey *et al.*, forthcoming 2012c) focuses on the main *barriers* to good waste management practice, which manifest as situational factors within the proximal context. This, the second paper, focuses on the *deeper structural forces*, within the distal context, which create these barriers and ultimately shape waste management behaviour in South Africa. By understanding the influence of the social, economic, and political structures that prevail in South Africa, and which impact upon the South African waste sector, we are better able to place these barriers in context and identify measures to support respondents in implementing good waste management practice within their organisations.

Numerous studies have focused on the effect of situational factors on behaviour, however very little research has been undertaken on understanding the influence of underlying societal structures on environmental behaviour (Binder, 2007; Tudor *et al.*, 2008). A review of the literature revealed limited research in applying structuration theory within the field of waste management, and in particular waste management in a developing country context such as post-apartheid South Africa, where the diversity and complexity of social structures are likely to play an important role. As a social system, post-apartheid South Africa exhibits a range of societal structures that define the social, economic, and political context of the country (Cohen, 1989;

Hart, forthcoming).

7.4. Theoretical framework

The theoretical framework adopted by Godfrey & Scott (2011) in the 2006 empirical study, was based on Miller & Morris' (1999) process of learning. The framework was shown to be simplistic for understanding the role of waste data in a developing country context such as South Africa (Godfrey & Scott, 2011). The authors expanded this preliminary theoretical framework in the 2011 empirical study, by combining Miller & Morris' (1999) process of learning with Ajzen's theory of planned behaviour (Ajzen, 1985; Ajzen, 1991). The results showed that while this expanded learning-behaviour theoretical framework allowed the authors to examine the relationship between data and behaviour, it could not explain the strong organisational and structural influences shaping intention and behaviour (Godfrey *et al.*, forthcoming 2012b). This paper further builds on the theoretical framework by recognising the status of the situated actor, as agent, and embedding the linear, learning-behaviour theories within structuration theory.

7.4.1. Structure-Agency

Human action is recognised as being both contextualised and constrained by broader structural forces (Pred, 1984; Johnston, 1986; Cloke *et al.*, 1999; Binder, 2007). Stern *et al.*, (1999) note that environmental behaviour is affected by two factors, the first being the person's capabilities, the second being the external, contextual variables such as socio-structural or economic variables, that either directly or indirectly support or constrain agency. Understanding these societal structures within which people operate is essential to understanding the range of human behaviour and the potential for resultant action (Walmsley & Lewis, 1984; Cloke *et al.*, 1999; Kollmuss & Agyeman, 2002).

The passive or active nature of human agency, or the degree of agency that humans possess, has been a question that has dominated structuralist and humanist approaches since the 1980s (Cloke *et al.*, 1991). Structuralist approaches view individuals as passive bearers of social structures where individual consciousness and intentionality are removed from the person and assigned to abstract societal structures (Sewell, 1992; Hay, 1995; Peet, 1998). This approach has been criticised for focussing too heavily on structure with the result that actors are dehumanized and people are reduced to passive parties (Peet, 1998; Griggs, 2000). Humanist approaches on the other hand, assume that the active, intentional, participant individual, who is able to freely exercise their will, has complete control over their behaviour (Johnston, 1986;

Hay, 1995; Graham, 1997). Where agency is overemphasized, the actions of individuals appear to be completely unconstrained by structural factors (Griggs, 2000).

One of the most influential attempts to combine the concepts of structure and agency, is Giddens' theory of structuration (Giddens, 1984). Structuration finds a middle ground between structuralism and humanism, by recognising the interplay of structure and agency, or the "*duality of structure*" (Cloke *et al.*, 1991; Walmsley & Lewis, 1993; Graham, 1997; Burton & Wilson, 2006). What Johnston *et al.* (1994:600) refer to as the "*intersection between knowledgeable and capable human agents and the wider social systems and structures*". In structuration theory, the relationship between structure and agency is seen as being reciprocal and mutually dependent (Johnston, 1986; Hay, 1995; Graham, 1997). Structuration is a reflexive, two-way process, where human actions intentionally or unintentionally shape the micro- and macro-level properties of society, but are in turn reshaped by that very society (Sewell, 1992; Graham, 1997; Giddens, 2001).

Agency can be summarised as the voluntary, independent actions of individuals. Humans are said to have agency when their actions are unconstrained by external forces (Barnes, 2000). Agency has also been described as the knowledge, capabilities and power people have to act (Orlikowski, 1991; Sewell, 1992; Johnston *et al.*, 1994; Peet, 1998). Power is the ability of agents to act upon, control or influence the actions of others, to achieve specific outcomes, or to change things from the way they otherwise would have been (Popenoe *et al.*, 1998; Haralambos & Holborn, 2004; Scholtes, 2009). According to Barnes (2000:3) agency is the "*unconstrained, autonomous source of power.*" From the perspective of behavioural theory, knowledge, capabilities and power are all tied up within Ajzen's construct of perceived behavioural control (capability and controllability). The theory of planned behaviour proposes that perceived behavioural control, when combined with attitude and subjective norms, shapes intention and resultant behaviour. Agency is therefore strongly embedded within Ajzen's theory of planned behaviour which was used as the initial theoretical framework for this research (Godfrey *et al.*, forthcoming 2012b).

Little (2007) defines structure as a system of geographically dispersed rules and practices that influence the actions and outcomes of large numbers of social actors. In structuration theory (Giddens, 1984), structure plays out through humanly produced rules and resources (Peet, 1998; Cloke *et al.*, 1999). These learned social rules may be formal or informal, written or unwritten, explicit or implicit (Pred, 1984). Rules become an underlying 'grammar' in the language of a community or society and are absorbed into, and taken for granted by that society (Pred, 1984; Spaargaren and van Vliet, 2000). Resources are the authority and property used to exert power

and influence, and in so doing shape social interactions (Cloke *et al.*, 1999:40). Rules and resources do not only enable or constrain agency, but also shape our beliefs and behaviour in a continuous process (Pred, 1984; Cloke *et al.*, 1999). According to Giddens, structures do not determine action, but rather limit the range of options available to an actor (Slattery, 2003; Haralambos & Holborn, 2004). Structures are therefore seen to restrict personal freedom; what Popenoe *et al.* (1998:44) refers to as the “*coercive power of social structure.*” Structuration theory suggests that neither structure nor agency can exist independently of one another (Haralambos & Holborn, 2004).

While structuration theory provides a basis for understanding behaviour within the context of social practices, it too has been criticised, particularly for being vague at the interface between agency and structure, instead, oscillating between the opposite poles of agency and structure (Pred, 1984; Johnston *et al.*, 1994). Structuration theory has been criticised for locking the concepts of structure and agency too closely together; for over-emphasising the power of individuals; and for underestimating the complexity of social life and the resultant constraints faced by individuals (Slattery, 2003; Haralambos & Holborn, 2004).

7.4.2. Towards a conceptual model of waste behaviour

Linear, social-psychological theories of environmental behaviour have been criticised for presenting the beliefs, norms and values of actors within a social vacuum (Spaargaren & van Vliet, 2000), and for not providing an empirical framework for analysing the interaction between individual intention, resultant action and the broader society (Spaargaren & van Vliet, 2000). As noted by Lucas *et al.*, (2008:458) “*environment-related behaviours [are] complex and non-linear, shaped by multiple antecedent factors applying in different sequences and with different weighting to determine the end behaviour.*”

Linear causal theories of agency, such as the process of learning and theory of planned behaviour applied by Godfrey *et al.* (forthcoming 2012b), provide a set of constructs for assessing the influence of knowledge on waste behaviour; however, they do not provide a conceptual framework for explaining the relationship between individual knowledge and behaviour, and the broader societal structures (Scoones, 1999; Scholtes, 2009). While structuration theory is not without critique, it does provide a useful conceptual framework, at a broader societal level, through which to examine the societal structures shaping good waste management practice.

Combining the three theories, allows the authors to build a more conceptually inclusive

theoretical framework, which is more useful in explaining the research findings than each of the theories on their own. By combining the theories, the authors move from an atomistic linear theoretical framework to a dialectical conceptual framework of 'situated actor'. It is accepted that this combination of frameworks creates tension between the strict binary logic of the causal positivist theories and the dialectical logic of structure-agency theory. This single theoretical framework is presented here as a novel conceptual model in the field of waste management (**Figure 7-2**).

Kollmuss & Agyeman (2002) in their evaluation of the attitude-behaviour gap, note that the interaction of internal and external factors shaping pro-environmental behaviour is complex, and can not be adequately summarised within a single framework. In putting forward this more inclusive theoretical framework, it is acknowledged that agency, and the interactions of actors within society, is a diverse and complex issue. It is not the intention of the authors to oversimplify behaviour and the duality of structure-agency, or provide a framework that will explain all aspects of waste behaviour. Instead, the proposed theoretical framework falls within a pragmatic approach, which provides an opportunity to explore and better understand the research question of the role of waste data in generating knowledge and influencing behaviour; and contextualising this behaviour within current societal structures, particularly as they relate to waste management in South Africa.

In summary, the premise that is put forward in this conceptual model (**Figure 7-2**), is that waste data becomes information through a process of assimilation and interpretation, which when combined with personal experience and theory, creates knowledge and a resultant improved ability. Through a learning process, this new knowledge has the potential to influence and alter behavioural intentions, by influencing behavioural beliefs, normative beliefs and control beliefs. However, not all behaviour is under volitional control. Since individuals are embedded within societal structures, behavioural, normative and control beliefs will be influenced by social, economic and political structures, which shape behavioural intention and resultant behaviour, and which in turn, reshape these same societal structures.

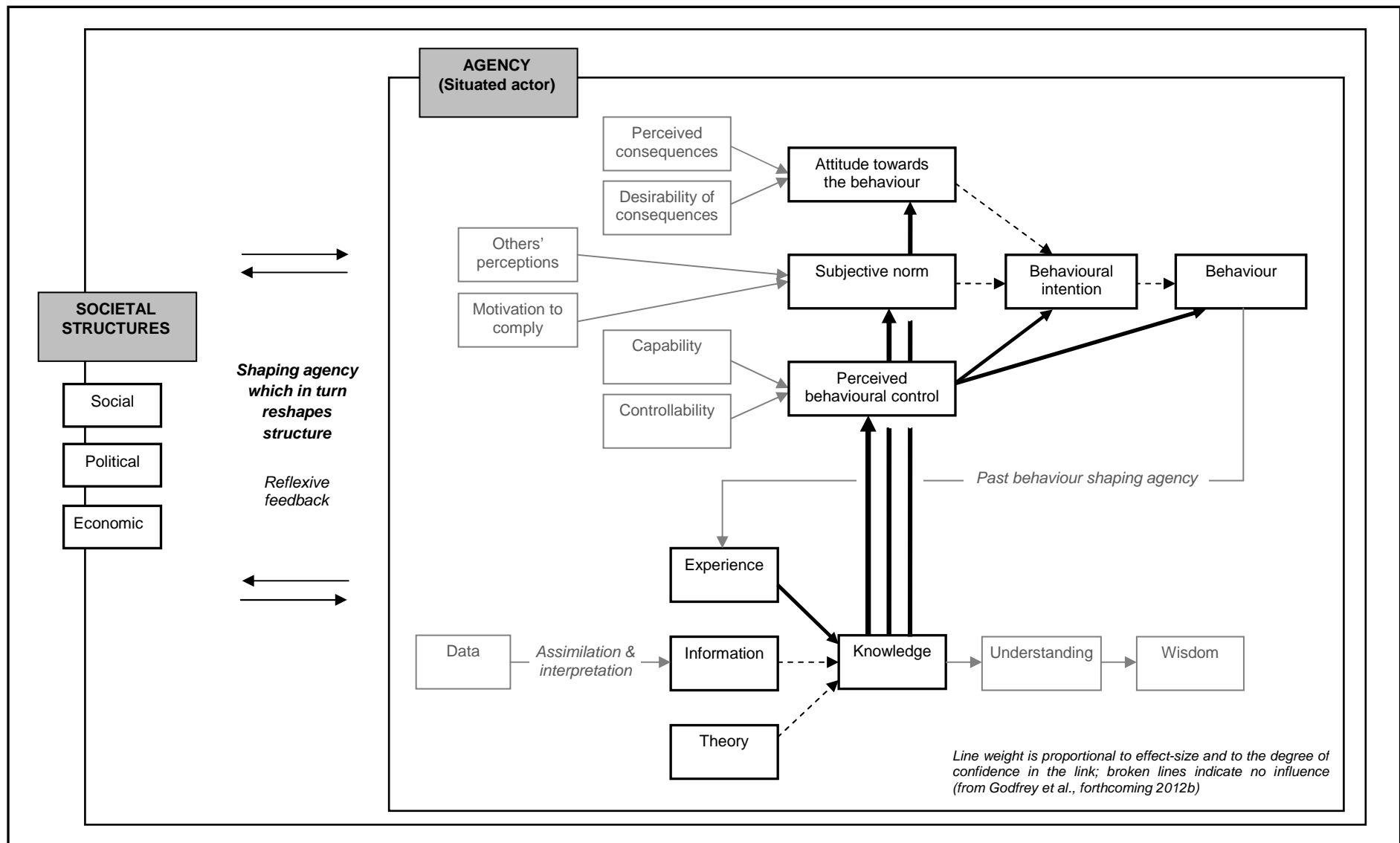


Figure 7-2. A conceptual model of learning-behaviour embedded within societal structures

7.5. Method

7.5.1. Participants

The research was undertaken with participants at public and private waste organisations that had submitted data to the SAWIS in 2009 and 2010. Of the 40 participating organisations (14 municipal, 26 private), two organisations were no longer contactable and seven organisations did not make themselves available to participate in the study. In certain organisations the responsibility for capturing the data, and uploading the data, has been split between different persons. In these cases, both persons were approached for interviews. From the 31 available organisations, 44 respondents participated in the study (15 municipal, 29 private).

7.5.2. Research design

Since societal structures are hidden systems that determine human agency, it is not always possible to identify and measure them directly and quantitatively (Peet, 1998). Individuals are also mostly unaware of the underlying structural forces that shape their behaviour. Asking respondents to identify the social, economic, and political structures that shape their behaviour is therefore likely to be a difficult exercise. The influence of structure on behaviour was therefore examined by asking respondents to identify the top three barriers to action (Godfrey *et al.*, forthcoming 2012c) and through analysis drawing inferences about the societal structures.

Given the apparent limitations of an exclusively positivist or interpretive approach, this research adopts a mixed-methods design (Gelo *et al.*, 2008; Teddlie & Tashakkori, 2009), combining both quantitative and qualitative research methods. Such an approach was found to be most suitable for the research question and purpose, thereby strongly supporting a pragmatic paradigm (Gelo *et al.*, 2008; Teddlie & Tashakkori, 2009).

Data were collected by means of semi-structured interviews, during which time a questionnaire was administered. The questionnaire consisted of two parts, Part I being a questionnaire of 57 closed questions completed by respondents, and Part II being an interview schedule of 11 open questions used to guide the discussion with respondents. Three open questions aimed at understanding the barriers to good waste management practice in South Africa are of particular relevance to this paper, and include: “*In your experience what are the top three barriers within your organisation to implementing good waste management practices?*”; “*Can you give an example, from your own experience, of one of these barriers that stopped you from implementing good waste management practices in your organisation?*”; and “*To what extent*

do you think that these barriers apply in other municipalities or private waste companies."

7.5.3. Analysis and interpretation

All interviews were transcribed, providing a large body of qualitative data, which were then coded and categorized into a small set of pertinent themes (Leedy and Ormond, 2005). These themes were derived through an inductive and interpretive process of seeking meaning in the data. Content analysis was applied in interpreting the data, which allowed the authors to delve into the meaning, perceptions and beliefs of respondents with regards to the management of waste in South Africa (Whitley, 2002; Henning, 2004). The results of the qualitative data analysis are presented as a narrative of the societal structures that shape agency in public and private waste organisations in South Africa.

The narratives are supported by statistical data obtained from the analysis of respondents' scores to the closed questions. Respondents were asked in the questionnaire to rate their response to given statements on a seven point semantic differential scale, ranging from 1 to 7 (strongly disagree/strongly agree). The scores were captured in a spreadsheet and used in further statistical analysis.

7.6. Results and discussion

7.6.1. Power to act

Relationships of power are a crucial element of Giddens' theory of structuration (Slattery, 2003). According to Haralambos & Holborn (2004:971), "*humans are constrained by the existence of power relationships.*" In response to the interview question: "*It is within my power to implement good waste management practices in my organisation*", average responses from municipal respondents ($\bar{x} = 5.07$; SD = 1.44) scored lower than those of private respondents ($\bar{x} = 5.89$; SD = 1.29). Municipal respondents only slightly agreed to having power to act. From the results, respondents from private organisations have more power to act than municipal respondents. Analysing responses to the question: "*I have the authority to implement good waste management practices in my organisation*", the average responses from municipal respondents ($\bar{x} = 4.47$; SD = 1.68) score lower than private respondents ($\bar{x} = 6.00$; SD = 1.12).

Evidence shows that respondents from municipalities have less power and authority to act than private respondents. One could ascribe these differences in power and authority between public and private organisations to differences in the respondents' hierarchy or status within the

organisation, as suggested by Popenoe *et al.* (1998). The results, however, show that 80.0% of respondents in municipalities classify themselves as middle or senior management, while only 69.0% of respondents in private organisations classify themselves as middle or senior management. One can therefore assume that more senior waste officials were interviewed in municipalities than in private organisations. Irrespective of a higher organisational standing, municipal respondents felt the constraints of greater structural forces. Status, or hierarchy, within municipalities may therefore not equate to a higher level of power.

The lack of power (and control) (Respondent 14, 15, 28) over these barriers and structural forces often results in disempowered agents, as seen in the weak translation of intention into behaviour (Godfrey *et al.*, forthcoming 2012b). From respondents interviewed in municipalities, there is evidence of low motivation to implement good waste management practice (Respondent 14, 19):

“So it’s trying to convince everyone that this is the correct thing to do and then only get approval and do it. But sometimes by that time you’ve lost some of your initial strive of wanting to get it done. Then you give up halfway” (Respondent 19).

7.6.2. Influence of structures on waste behaviour

Godfrey & Scott (2011) recognised signs of societal structures in the way respondents from public and private organisations went about waste data collection, and how this data was used within the organisation. Godfrey *et al.* (forthcoming 2012b), showed empirically that respondents in different organisational types are subject to different societal structures, in the way knowledge, intention and behaviour are constructed, and in how intention is translated into behaviour.

From the main barriers to good waste management practice Godfrey *et al.* (forthcoming 2012c) (**Table 7-1**), the authors were able to infer some of the social, economic, and political structures that shape agency in different organisational types. It is not the intention to provide a comprehensive understanding of all societal structures shaping waste management in South Africa. Instead, the following section aims to provide evidence for the dominant structures that influence the waste behaviour of respondents in participating organisations.

7.6.2.1. Social structures

While there is little doubt that social structures such as *culture* and *race* do influence waste behaviour at an organisational level in a transforming South Africa, there was little overt evidence for this from the interviews conducted. A post-1994 racially transforming public

sector, driven by political forces, has created organisational barriers to action, but this has been more a result of the rapid rate of transformation, and with it, the initial lack of skills and experience of persons appointed (Godfrey *et al.*, forthcoming 2012a).

Table 7-1. Dominant barriers to action and associated societal structures

Organisation	Dominant barriers ^{*)}	Societal structures
Municipalities	<ol style="list-style-type: none"> 1. Insufficient funding for waste management and resultant lack of resources (including equipment and personnel) 2. Insufficient waste knowledge at various levels within the organisation 3. Political interference in decision-making in the municipality 4. Compounded by a slow decision-making process 5. Lack of perceived authority to act by waste staff 6. A low priority afforded to waste 	<ul style="list-style-type: none"> • Social <ul style="list-style-type: none"> ○ Culture ○ Race • Political and legal <ul style="list-style-type: none"> ○ Organisational transformation ○ Bureaucracy ○ Social redress ○ Political alliances ○ Legislative reform ○ Co-operative governance
Private industry	<ol style="list-style-type: none"> 1. Insufficient funding for waste and resultant lack of resources (including equipment and personnel) 2. Insufficient waste knowledge at various levels within the organisation 3. Government bureaucracy to managing waste 	<ul style="list-style-type: none"> • Economic <ul style="list-style-type: none"> ○ Neo-liberal capitalism ○ Privatisation of public services ○ Globalisation
Private waste companies	<ol style="list-style-type: none"> 1. Increasing costs of doing business 2. Government bureaucracy 3. Global markets 4. Availability of waste for recycling 	

^{*)} Barriers to implementing good waste management practice (from Godfrey *et al.*, forthcoming 2012c)

7.6.2.2. Economic structures

The most dominant structure in contemporary society is the *global neoliberal economic system*, which determines and influences social, economic, political, legal, and institutional structures (O'Hara, 2006). South Africa is no exception. The change in government in 1994 saw the introduction of new economic, labour and social policies, such as the Reconstruction and Development Programme (RDP), the Growth, Employment and Redistribution Policy (GEAR) in 1996, and the New Growth Path (NGP) in 2010 (Williams & Taylor, 2000; Lewis, 2001, Republic of South Africa, 2010). GEAR, a neoliberal macroeconomic policy, aimed to establish a competitive fast-growing economy that linked South Africa to a global economy (Republic of South Africa, 1996a). The neoliberal ideology in these early economic policies promoted the roll-back of the state, privatisation of services and pro-growth development

(McDonald & Pape, 2002; O'Hara, 2006). The NGP, which has been rejected by many South African trade unions for continuing the neo-liberal ideology of former policies (Cosatu, 2011), aims to “*achieve a more developed, democratic, cohesive and equitable economy and society over the medium term, in the context of sustained growth*” (Republic of South Africa, 2010:1).

These socio-economic policies have shaped South African society over the past decade, and have called for radical political, legislative and organisational transformation in the public and private sectors (Labour Market Commission, 1996; Republic of South Africa, 2010). The impact of these policies is evident within the restructured public sector, which has undergone transformation of both its workforce and operations. This was undertaken in an attempt to increase the efficiency of capital expenditure and service delivery required under GEAR (Republic of South Africa, 1996a) and to address previous racial, gender and public sector wage disparities (Labour Market Commission, 1996; Altman, 2005). Under these policies, municipalities have been tasked to implement measures that seek to redress apartheid inequalities in service delivery, as well as promote pro-growth economic development. According to Hart (forthcoming), this creates tensions at a local government level between a municipality's role in a neoliberal post-apartheid economic climate, and the political need for social redress of previously disadvantaged communities.

South Africa's approach to economic development is considered to be at the expense of environmental conservation (Burns & Hattingh, 2006; Oelofse *et al.*, 2006). GEAR's approach to environmental management is a conservative one, making no reference to the environmental capital required to support such development. Instead it focuses on short-term economic development, resource exploitation and environmental trade-offs in support of social redress, resulting in a misalignment with national environmental policy such as NEMA (Jones, 2001; Burns & Hattingh, 2006). The Environment Outlook report for South Africa shows deterioration in 28 of South Africa's 47 environmental indicators (60%), with deterioration in both water and air quality (DEAT, 2006). The environmental sustainability index for the country has declined to an overall rank of 93 out of 146 countries in 2005, suggesting a worsening in the condition of South Africa's natural resource base (DEAT, 2006). In the absence of reliable data, a perception also exists within the waste community, that the management of waste and waste facilities in South Africa has also deteriorated over the past two decades. New economic policies stimulating economic growth and development have placed a growing demand on the country's natural resource base. However, new environmental policies appear to have little effect on minimising the impacts on the environment, or on reducing the volumes of waste being generated.

Post-1994 socio-economic policies are also evident in shaping the management of waste in South Africa, in particular the roles of the public and private sector. Waste is now managed across all three spheres of government (national, provincial and municipal), with policy providing an outline of the specific roles and responsibilities of these spheres (Republic of South Africa, 1996; 2000). According to the Constitution (Republic of South Africa, 1996) and the White Paper on Integrated Pollution and Waste Management (Republic of South Africa, 2000), the management of waste is devolved to municipalities, as the lowest tier of government. Municipalities have a dual waste role - as both regulator of waste management activities and as waste service provider. As service provider, municipalities are responsible for providing waste management collection services to local communities and businesses, and managing public waste disposal facilities. In practice, domestic waste is largely collected by municipalities, with this waste being disposed of to public waste facilities, still predominantly landfill sites. Commercial and industrial waste is typically managed by private waste companies and disposed of to private or public waste facilities. The management of hazardous waste remains largely the domain of private waste companies. However, there is a growing trend in the *privatisation*, including outsourcing, of domestic waste services by municipalities, in particular the operation of municipal landfill sites (Samson, 2003). This has been done in an attempt to address many of the barriers created by post-1994 political structures (Godfrey *et al.*, forthcoming 2012c). Research shows that outsourcing waste operations to private contractors results in improved services and reduced costs to the municipality, if managed correctly (Godfrey *et al.*, forthcoming 2012c). However, unions remain strongly opposed to the privatisation of municipal services, due to the potential for wage cuts and job losses, and in particular what becomes the ‘de-politicised downsizing’ of operations in the hands of private companies, who are driven by efficiency and cost-recovery (Nedlac, 2002; Samson, 2003).

The need for social redress of historical inequalities in South Africa plays off against a strong neo-liberal, capitalist economy, with an “*insatiable search for private profit*”, which has continued to perpetuate inequality (Slattery, 2003:3). Dominant economic structures shaping agency in private waste organisations are neo-liberal *capitalism* and *globalisation* as shown in the narrative of respondents. Over half (61.9%) of respondents from private organisations voluntarily emphasised that “this is a business”, and that implementing good waste management practice is based on business decisions:

“*That’s our business... to make money*” (Respondent 11).

“*As a business you need to decide can you afford to add a scrubber and still keep the business running going forward, or is it not feasible and then maybe you need to look at shutting down your facility rather than upgrading it to meet legislation*” (Respondent 8).

Giddens (1997:63) defines globalisation as the “*increasing interdependence of the world.*” This interdependence has created a single social system, with social, economic, and political structures now cutting across political borders and directly influencing the behaviour of people globally (Giddens, 1997). The effect of **globalisation** is evident on local recycling markets (Respondent 20, 25), and on the international prices of recyclable commodities (Respondent 24, 35). As noted by respondents from private waste organisations:

“We’re competing in a global market at the moment. And paper that lands in South Africa, lands here cheap, very cheap. We used to sell a whole range of products into Europe and it just got to the stage where we can’t compete. [Supplying only into South Africa] is a big problem, because the South African market is not big enough. The [paper recycling and manufacturing] industry is under significant pressure from Indonesia, Brazil, China and India. They bring in large quantities of paper and it’s at the cost of production here, or cheaper in many cases” (Respondent 20).

“We’ve got major, major hassles with imports. Imports are killing us, imported [product]. They can import the [product] from China and Korea, 30% cheaper than we can manufacture it [locally], although we’re recycling. So we’re just hoping for the exchange rate to change and the Chinese to put legislation in place” (Respondent 25).

The *global economic recession* has also impacted upon the ability of respondents to implement good waste management practice in South Africa by restricting available resources in local businesses (Respondent 3, 4, 24). The recession that hit South Africa in the first quarter of 2009 (Statistics South Africa, 2009) impacted on both private industry and well as private waste companies in a number of ways. First, it directly affected the ability of private industry to implement waste projects due to financial constraints (Respondent 3, 4, 24). Second, private waste companies noted that they were receiving less waste because industry could not afford to shut down operations to do big cleanups, waste was being stored on-site longer by industry before disposal, and smaller amounts were being sent for disposal, often raising questions around illegal dumping (Respondent 8, 22). Third, the demand for packaging material decreased during the recession, and as the demand for packaging declines, so does the recovery of packaging for recycling (Respondent 20). Just over half of respondents from private organisations (52.4%), noted the impact of the global economic recession on their business. *“In the year that the whole recession happened, all environmental projects [in our company], well for that matter every single project, was immediately put on ice”* (Respondent 4).

7.6.2.3. *Political and legal structures*

Political transformation following the establishment of a democratic South Africa in 1994 ushered in rapid *organisational transformation*, particularly in government departments. According to respondents, this has resulted in a lack of knowledgeable employees who do not have the experience to manage increasingly complex problems, such as waste management (Respondent 1, 4, 18, 26, 28). The rapid transformation of the public sector has raised concerns around issues such as incompetence, corruption, nepotism and tender irregularities (Respondent 1, 6), with the result that power and decision-making is now centralised to municipal councils and senior management in local government. This has resulted in an increase in structural rules being implemented in government in the form of policy and legislation. These institutional systems and procedures are seen as cumbersome *bureaucratic and administrative procedures* reducing the volitional control of respondents in municipalities (Respondent 9, 15, 19, 28). According to Hart (forthcoming), the increase in administrative procedures is as an attempt by national government to tighten '*fiscal austerity*' and operate municipalities as a business within South Africa's post-apartheid neoliberal ideology. This is what Miraftab (2004) refers to as the '*corporatization*' of local government. The effect of these bureaucratic government procedures are also felt by respondents in private companies (Respondents 4, 7, 8, 20, 22, 38). This was evident in the frustrations experienced due to the slow issuing of licences and permit amendments by government, required by respondents in private companies to implement new waste management practices.

Political transformation has also called for post-apartheid *social redress and social spending*, which is shaping waste behaviour (RSA, 1996). From the discussion with respondents, the imperative to undertake social redress is particularly evident in local government. Social redress, and the associated allocation of municipal budgets, has resulted in the reallocation of government spending towards social issues; job creation in the public sector; and expanding roles of local government to include social development. All of which directly impact upon respondents tasked with the management of waste in municipalities. Social redress has resulted in the *reallocation of government spending* to previously disadvantaged communities and to prioritised services such as housing, electricity, water and sanitation, with the result that waste (and the associated allocation of funding) is seen as a lower priority to municipalities (Respondent 1, 12, 13, 14, 26). In addition, the development role of municipalities involves promoting social and economic development of communities through new enterprise and job creation, and increasing the basic service delivery function of municipalities (Respondent 18, 28). The expectation by national government that municipalities fulfil this developmental role creates tension between a strongly capitalist, neo-liberal business approach to managing municipalities (a pro-growth mandate) and their role in social development, service delivery and

poverty alleviation (a pro-poor mandate). According to Hart (forthcoming): “*broadly speaking local government is the impossible terrain of official efforts to manage poverty and deprivation in a racially-inflected capitalist society marked by vicious inequalities which, since 1994, have become simultaneously de- and re-racialized*” (Hart, forthcoming:32).

With this transforming public sector has come a call for *job creation* in response to current levels of unemployment, even while the private sector is shedding jobs in response to the economic recession (Godfrey et al., forthcoming 2012c). Continued employment in the public sector impacts upon municipal budgets, with greater amounts now going to salaries and not equipment. This lack of budget for capital expenditure to purchase equipment and upgrade waste facilities makes it difficult for municipalities to implement good waste management practice (Respondent 1, 28). The strength of South African *unions through their political alliance* with the ruling party, the ANC, is evident in the public sector, where unions have pushed for above-inflation related wage increases and continued employment, to the extent that operational costs in municipalities now constrain their ability to implement service delivery. This same drive for employment has seen unions opposed to the outsourcing of waste operations in municipalities, even though there is evidence for improved facility operation at a reduced cost (Godfrey et al., forthcoming 2012c). Management in municipalities are not seen to oppose unions because of this political alliance, with the result that unions interfere in the operations of local government (Respondent 1). Unions have also pushed for above-inflation related salary increases in the private sector, through industry bargaining councils, often to the detriment of local business and job creation (Respondent 25).

The period post-1994 has also been one of major *legislative reform*, with the introduction of new *political and legal structures*, roles and responsibilities, which have filtered down into environmental management functions. The surge in environmental and waste policy legislation over the past two decades (**Figure 7-3**), was sparked by South Africa’s constitutional reform process, which identified environmental protection for present and future generations as a basic human right enacted within South Africa’s Constitution (Republic of South Africa, 1996).

The most significant environmental legislation since 1994 has been the promulgation of the National Environmental Management Act (NEMA) (Republic of South Africa, 1998), the umbrella environmental legislation for all subsequent acts, e.g. NEM: Air Quality Act; NEM: Waste Act. The NEMA puts forward the post-apartheid government’s philosophy with respect to environmental management.

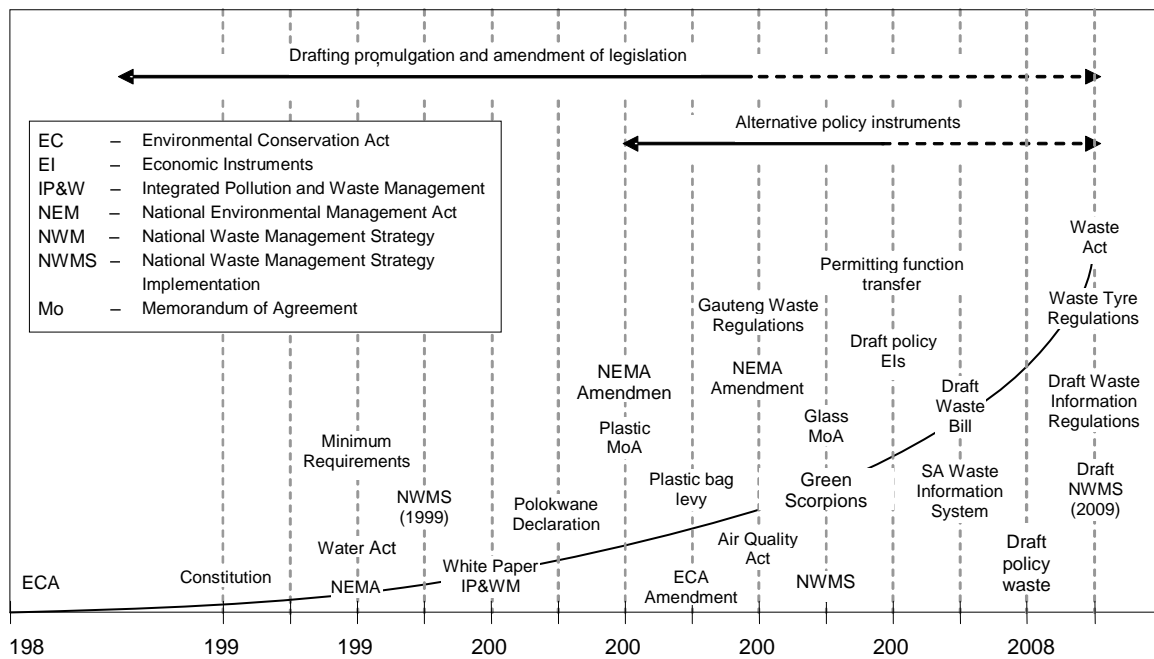


Figure 7-3. Key South African waste policies and legislation enacted during the past 20 years (adapted from Godfrey & Nahman, 2008)

Until recently, South Africa has had a fragmented regulatory approach to waste management (DEAT, 1999; Republic of South Africa, 2000). Waste has been managed under numerous pieces of legislation, including amongst others, the Environment Conservation Act (Act 73 of 1989), the National Environmental Management Act (Act 107 of 1998), and the National Water Act (Act 36 of 1998). The fragmentation of waste legislation in South Africa has made enforcement difficult in terms of both legal and administrative requirements (Engledow and Groeners, 2008). The first consolidated waste legislation for South Africa, the NEM: Waste Act (Act 59 of 2008) has only recently been promulgated, with many sections of the act still to come into effect (Republic of South Africa, 2009). The promulgation of new waste legislation, while still early, is already showing signs of re-shaping waste management in South Africa.

Legislative reform, as a structural force, is reported by respondents to be both a constraint to agency (Respondent 3, 20) as well as an enabler (Respondent 1, 15, 19). As enabler, we see how changing the structural rules at a national level, through new legislation, is helping to overcome barriers and return agency to those tasked with implementing good waste management practice. In particular, the new Waste Act and supporting regulations is helping respondents implement new waste programmes and access additional organisational funding. As noted by two respondents from municipalities:

“Especially with your legislation that is there now. We can use that now as a hiding stick to go to senior management and tell them ‘listen we have to adhere to this

because there's legislation that's going to hit us', so that's helping. So some of the things that we've achieved we used the legislation as an excuse” (Respondent 15).

7.6.3. Reclaiming agency

There is growing debate in the public arena as to whether these dominant socio-economic structures, such as global neoliberalism, are the cause of barriers to action (Rudin, 2011), or whether they have simply become excuses for the non-performance and non-delivery of individuals (Koelble & Siddle, 2011), particularly in local government. The way in which certain respondents have been able to reclaim agency despite these barriers, while others remain subject to them, suggests an element of truth in both arguments.

Agency is the ability of individuals to adapt their behaviour to the situation (Slattery, 2003). While not specifically asked of respondents during the interviews, some respondents volunteered examples of how they have overcome the barriers they face and have reclaimed their agency. The commitment to their job, in spite of the barriers, is shown in the following statement by a municipal respondent:

“I will never [give up], I will never do that. Sometimes you feel negatively but then you must sit down and decide I'm going that route. Either way, the work has to be done.” [Sometimes you] rather leave it and don't make a right decision or the wrong decision. But we take the risk” (Respondent 15).

Very often, reclaiming agency has involved bending the very rules that make up these structures. Examples of where respondents in municipalities have overcome the barriers of a lack of funding and slow bureaucratic processes, and have reclaimed their agency and the ability to implement good waste management practice, include the outsourcing of landfill operations and the hiring of equipment. Respondents in municipalities reported how a lack of funding, particularly for capital expenditure, was making it difficult to fulfil their functions (Godfrey *et al.*, forthcoming 2012c). Outsourcing of municipal landfills to private contractors, thereby operationalising the expenditure, has given municipalities access to better resources and knowledge in the private company. It also has the benefit of costing the municipality less (Respondent 1, 13, 14, 18, 28). Hiring of waste collection vehicles and landfill equipment (Respondent 9) has also allowed respondents in municipalities to overcome barriers of a lack of funding for capital expenditure, a lack of adequate facilities for maintenance within the municipality, and slow procurement and administrative processes within the municipality.

Examples are evident of how the same barrier (lack of equipment in the municipality) in one

instance disempowers agency, whereas in another municipality, creative ways are identified to work around the rules and in so doing, reclaim agency.

“Another vehicle broke down [and] the mechanics just say ‘no, sorry we’re leaving at 1pm, it’s your problem’. So we really have a problem. We cannot go outside to a company and say ‘please help us’ because the supply chain and the Municipal Finance Management Act ... you know there’s so many things that block you” (Respondent 15).

“We have become creative to come up with ways of solving our problems before they happen. For example, we went out on tender for the hiring of equipment for a 2 year contract. So having that contract enables us to take a decision within a short space. If we didn’t have any alternative solution we would have had to wait, to write letters and have them approved and.... So we’ve created for ourselves some small open doors” (Respondent 28).

This difference in agency to the same barrier highlights the importance of understanding the individual within the theoretical framework (**Figure 7-2**). However, such an understanding of agency is only possible when placing the individual within the broader societal context.

7.7. Conclusions

Research into the South African Waste Information System (SAWIS) over the past five years has provided a unique opportunity to inductively build a conceptual waste model of the knowledgeable, situated actor, presented in this paper. The model combines three theoretical approaches – the process of learning, the theory of planned behaviour, and structuration theory – to jointly address the research question – *whether the collection of data for a national waste information system can change the way waste is managed in South Africa, such that there is a noticeable improvement*. Research into understanding the influence of SAWIS waste data on behaviour in South Africa has until now, largely focussed on the role of individual agency, through a combined learning-behaviour theoretical framework. This paper highlights the importance of societal context in shaping behaviour by placing the situated actor within a theory of structure-agency.

From the identified barriers to good waste management practice (Godfrey *et al.*, forthcoming 2012c), the authors have been able to make inferences regarding the social, economic and political structures that shape waste behaviour in South Africa. Situated within a neoliberal capitalist economy, South Africa is undergoing major political, legislative, and organisational transformation following the establishment of a democracy in 1994. The research shows that

structures do influence waste behaviour in South Africa. While social structures such as culture and race are likely to impact on waste behaviour, it is the strong competing political and economic tensions within South Africa that are currently the most dominant structural forces on waste management.

The conceptual model is shown to be a useful framework for understanding how societal structures contextualise and constrain waste behaviour within public and private waste facilities in South Africa. In particular, it provides an approach to understanding the creation and execution of individual and institutional power to act in the management of waste in a developing country, viewed through the lens of a national waste information system. Recognising the unique contribution of both the individual and societal context is important in developing behaviour change mechanisms. Policy mechanisms, for example, to ‘internalist approaches’ have focused on changing beliefs through awareness raising and knowledge building. Policy responses to ‘externalist approaches’ have called for a change in the structures, through new rules and resources, thereby creating the right environment for behavioural change (Jackson, 2005:89). Our research shows, that the best approach is to address both; to support activities that will change beliefs and resultant waste behaviour, while at the same time reshaping the various dimensions of the social, economic, and political structures that may constrain agency. It is acknowledged that some structures, such as a capitalist neoliberal economy, cannot simply be removed to improve waste management in South Africa, however, the ability of individuals to reclaim agency in spite of these barriers, shows that it is possible to constructively ‘work-around’ or ‘work within’ these structures.

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CHAPTER 8: SUMMARY AND CONCLUSIONS

SUMMARY AND CONCLUSIONS

8.1. Introduction

The aim of this research has been to explore the question: ‘*Can the collection of data for a national waste information system, change the way waste is managed in South Africa, such that there is a noticeable improvement?*’ By addressing this question, the author also aims to make a research contribution to the theoretical debate on the role of data and knowledge in shaping waste behaviour, as well as practical recommendations that will improve the way waste is managed in South Africa. To adequately address this research question, a number of sub-questions were identified:

1. What are the waste data needs in South Africa?
2. What is the current role of waste data in managing waste in South Africa?
3. What influence does SAWIS data have on building waste knowledge?
4. What influence does SAWIS data have on waste behaviour?

During the exploration of sub-question (4), two more sub-questions emerged, which were included in the research:

5. What are the barriers to good waste management practice?
6. What are the underlying societal structures that shape waste behaviour?

Having elected to undertake the PhD by means of published papers, each of the chapters of this thesis has addressed one of these sub-questions. Within the chapters each of these sub-questions have, in instances, been further broken down into more detailed research questions and hypotheses, as summarised in Section 8.3.

8.2. Review of research method

A mixed-methods research design, situated within a pragmatic paradigm (Gelo *et al.*, 2008; Teddlie & Tashakkori, 2009), was felt to be most appropriate for answering the research question and sub-questions posed at the outset of this research. Situating the research in this paradigm allowed the author to draw upon appropriate research methods at different stages in the research. It provided a practical approach to this trans-disciplinary research while still allowing the research to be placed within the body of international literature on the application

of the theory of planned behaviour. A mixed-methods design allowed the researcher to overcome the small population size and address the competing influences on waste behaviour. While quantitative methods were used to show the contribution of data to knowledge, and knowledge to behaviour, this research has been able to achieve a deeper understanding of the role of waste data in influencing behaviour, through the application of both qualitative and quantitative methods, where appropriate.

A pragmatic approach to trans-disciplinary research has been supported by researchers such as Messerli & Messerli (2008) and Keune *et al.* (2011), as the research draws upon and integrates very different social and natural science research paradigms, methods and tools in an effort to provide research which is practical and policy relevant. The pragmatic approach is appropriate for research in the discipline of engineering, which is increasingly recognising the value of epistemological diversity and trans-disciplinarity (Ge *et al.*, 2008; Douglas, 2010). Many theorists suggest that a pragmatic paradigm bypass the debate over opposing epistemological, ontological and methodological assumptions of positivist and interpretive paradigms and instead focus on a context-driven research approach. With this understanding, quantitative and qualitative research methods were applied both sequentially and concurrently in this research, depending on the specific sub-question being addressed (Gelo *et al.*, 2008).

Furthermore, neither the quantitative nor qualitative methods, on their own, would have provided a full answer to the research question. A quantitative approach, framed within a positivist philosophy, would not have been able to take the research beyond the preliminary linear, learning-behaviour theoretical framework. Similarly a qualitative approach, within an interpretive philosophy, would not have been able to unpack the relationships between data, knowledge, beliefs and behaviour. By framing this research within a pragmatic paradigm and adopting a mixed-methods research approach, the author has been able to explore the influence of both internal and external forces on waste behaviour, through both quantitative and qualitative research methods.

8.3. Summary of the research

The aim of this section is not to summarise all of the research findings again in detail. Conclusions have already been provided in each of the chapters for this. Instead, the aim of this section is to present the key research findings; to summarise the body of research in its entirety; and to show how the research findings fit together and help build the arguments presented through the course of the chapters (and papers).

The first of the research papers (Godfrey, 2008) (**Chapter 2**) explores the sub-question: ‘*What are the waste data needs in South Africa?*’ As a pre-development introduction to the SAWIS, the paper explored two research questions: ‘*How can the needs of government direct or shape the development of a sustainable WIS?*’ and ‘*How can an information system support effective integrated waste management?*’ As custodian of the SAWIS, the focus of these questions was on understanding the waste data needs of the three spheres of government – local, provincial and national government. To address these research questions, the research involved a participatory needs analysis process with representatives of government departments, which involved both quantitative and qualitative research methods. This process included stakeholder workshops with representatives from provincial and national government, and the completion of self-administered postal questionnaires by representatives of local government. The results showed that government’s needs for waste data reflect greater, currently unfilled needs in the sustainable management of waste in South Africa, i.e. waste management governance challenges currently facing the country. Requirements for waste data centred on strategic waste issues at national government to basic operational issues at local government. This understanding, that waste data needs reflect problems currently being experienced in the South African waste sector, was important for designing a useful, sustainable and practical waste information system. By designing the SAWIS to collect the types of data required by government, it was posited that waste data can support the improved management of waste in South Africa.

The second research paper (Godfrey & Scott, 2011) was prompted by the conclusions of the first paper (Godfrey, 2008). For waste information to support waste policy objectives and the needs of stakeholders, waste data needed to move beyond simple data collection to the generation and application of new waste knowledge. The rationale being, that only with increased knowledge and ability, was there likely to be a change in the way waste was managed in South Africa. The second paper focuses on the sub-question: ‘*What is the current role of waste data in managing waste in South Africa?*’ (**Chapter 3**). The empirical study, undertaken in 2006 at the end of the year of piloting of SAWIS, addressed three further sub-questions: ‘*Do organizations have the ability to collect data on solid waste?*’; ‘*Do employees have the ability to assimilate and interpret the data and through a learning process build new knowledge?*’; and ‘*Do employees (and organizations) have the ability to convert this knowledge into impact (potential to implement change in managing waste)?*’ Guided by a preliminary theoretical framework of learning (Miller & Morris, 1999) (**Figure 8-1**), these sub-questions supported the interpretation of the qualitative data. The data was collected by means of semi-structured interviews with respondents of the SAWIS pilot project. The results showed that certain organisations, mainly private waste organisations are well positioned to collect waste data,

having already implemented waste data collection systems prior to the piloting of SAWIS. In certain organisations this waste data was being assimilated and interpreted, which allowed respondents to identify where improvements in waste management were necessary. However, little evidence existed to show the operational impact of this waste data and the knowledge generated from it. While the desire was found to exist in individuals for improved waste practices, a change in waste operations was not evident due mainly to issues of governance and resource constraints. Given that all private waste companies were already collecting waste data prior to the piloting of SAWIS (to support financial and environmental-reporting business obligations); it was also not possible to distinguish any changes in waste operations due to the SAWIS data, from these existing drivers. The preliminary theoretical framework of learning was found to be too simplistic to adequately understand the role of waste data on behaviour, particularly in a developing country context such as South Africa.

The 2006 empirical study (**Chapter 3**) provided early signs of the influence of external, societal factors on the collection of waste data and on the utilisation of this data. These external forces were more evident within municipalities than within private waste companies. The evidence of societal forces prompted the inclusion of open questions around the barriers to action in the 2011 empirical study, which were further explored in **Chapters 5** and **6**.

The empirical study presented in **Chapter 3** made use of predominantly qualitative research methods. This was due to the small population size and the difficulty in providing a statistically significant quantitative measure of the influence of waste data on behaviour. These limitations were overcome in **Chapters 4** and **5**, as a result of the increased SAWIS population size available to the study five years after implementation of SAWIS, and by refining the theoretical framework to include the theory of planned behaviour (Ajzen, 1985) (**Figure 8-1**).

Recognising the potential for data to build knowledge in the 2006 study, the further research (**Chapters 4-7**) was based on the premise that the route of waste data to behaviour is via knowledge. Miller & Morris' (1999) process of learning identifies data as one of three important components of knowledge and as such, still provides a relevant theoretical framework for exploring the research question. **Chapter 4** revisits the relationship between data and knowledge using both quantitative and qualitative methods, in an attempt to address the third research sub-question "*What influence does SAWIS data have on building waste knowledge?*" The research puts forward three hypotheses, each related to the influence of the three constructs (experience, data/information, theory) on knowledge. By adopting a mixed-methods approach, the author has been able to explore the relationship between data, knowledge, beliefs and behaviour, by means of quantitative data while at the same time obtaining a deeper

understanding in these relationships through the collection of a rich set of qualitative data. Given the relatively small population size, partial least squares path modelling (PSPM) and not traditional structural equation modelling (SEM) was felt to be most appropriate, and has been used to analyse the quantitative data. Validation of the model provided confidence in the quality of the measuring instruments used in the research and in the method of analysis applied. The result of fitting the quantitative data to the theoretical framework of learning, showed that it is currently an individual's experience that has the greatest influence on building the waste knowledge of respondents in participating organisations. Data/information and theory were shown to have minor influences on knowledge generation. Together the three variables accounted for 54.1% of the variance in knowledge. These findings were corroborated by the qualitative data, which further showed that waste experience is mainly built through learning from others on the job, including colleagues but also importantly service providers such as consultants, contractors, and equipment suppliers. Country-to-country city twinning programmes in municipalities have also been a successful way of building local waste experience.

The results also showed that there are two distinct sub-groups in the data set, subject to different influences and behaviours, namely public and private waste organisations. From the quantitative data, knowledge was shown to be constructed differently for respondents in these different organisations, with theory and information having a greater influence for municipal respondents, and experience having a greater influence on behaviour for private organisation respondents. This was not supported by the qualitative data which found experience to be the dominant means of building knowledge for respondents in both public and private waste organisations. For most respondents, there is a sense that waste data has had a positive impact on the way their organisations manage waste, however they do not feel that it has been the data, per se, that has been the cause of the operational response, but rather the resultant knowledge that comes from the data.

This conclusion formed the starting point for the fourth sub-question, "*What influence does SAWIS waste data have on waste behaviour?*" (**Chapter 5**). The influence of SAWIS data on waste behaviour was explored by building a conceptually more inclusive learning-behaviour theoretical framework. This novel conceptual framework for the South African waste sector was achieved by combining Miller & Morris' (1999) process of learning and Azjen's (1985) theory of planned behaviour (**Figure 8-1**). Combining the theories allowed for the testing of 11 hypotheses. The results supported six of the hypotheses, and showed that knowledge has a significant influence on behavioural, normative, and control beliefs. However, it is perceived behavioural control (PBC) and not intention that has the greatest influence on good waste

management practice and the only direct effect on behaviour. While respondents may have an intention to implement good waste management practice, this intention is not translated into actual behaviour, suggesting that good waste management practice is not always under the volitional control of respondents. The evidence shows that there are only three constructs that currently have a significant effect on behaviour, namely experience, knowledge and PBC. Waste data was shown to have no significant direct or indirect influence on waste behaviour, however respondents have a sense that waste data has had an impact on the way their organisations manage waste.

By combining the two linear theories, the refined learning-behaviour theoretical framework accounted for 53.7% of the variance in behaviour. This suggests that there are still significant external influences on behaviour not accounted for by this framework. The results support the position of others, such Gardner & Stern (1996); Pfeffer & Sutton (2000); and Barr (2007) from the fields of environmental education and environmental psychology, in that data, information and resultant knowledge, while recognised as having an influence on behaviour, are not sufficient on their own to change behaviour. While the expanded learning-behaviour theoretical framework accounts for more variance in behaviour than many other empirical studies have found, the results still suggest a significant influence from other factors, including external forces. As in the case of knowledge, the results show that behaviour is constructed differently for respondents in public and private waste organisations suggesting that respondents in these different organisations are subject to different external structural forces.

The weak translation of intention into behaviour, and the differences in the construction of knowledge, intention, and behaviour for respondents in public and private organisations, prompted two additional sub-questions and a further refinement to the theoretical framework. In this way the author was able to explore the existence and nature of these external forces that shape behaviour and which create barriers to good waste management practice (**Chapters 6-7**).

Supported by a framework of societal context (Eaton *et al.*, 2003), **Chapter 6** explored these barriers to action, particularly as they manifest within the organisational environment. Qualitative research methods were felt to be most appropriate in exploring the existence and nature of these barriers. The results, presented as the respondent's narratives of perceived barriers, showed that respondents in municipalities perceive greater barriers to action than respondents in private waste companies. The main barriers to implementing good waste management practice experienced by respondents in municipalities included: insufficient funding for waste management and resultant lack of resources; insufficient waste knowledge; political interference in decision-making in the municipality; a slow decision-making process;

lack of perceived authority to act by waste staff; and a low priority afforded to waste. Barriers experienced by respondents in private industry included: insufficient funding for waste and resultant lack of resources; insufficient waste knowledge; and government bureaucracy. Respondents in private waste companies felt that barriers to action were mostly solvable, however, where barriers were experienced, these included: increasing costs; government bureaucracy; global markets; and availability of waste for recycling.

The results presented in **Chapter 6** support the position of others, such as Stern (2000), Lucas *et al.* (2008) and Fudge & Peters (2011), who found the theory of planned behaviour to be too atomistic, assuming that impact is only the sum of individual behaviours. The theory of planned behaviour does not provide sufficient guidance on how to address external influences with respect to individual behaviour, and in particular societal context, even with the inclusion of perceived behavioural control as an antecedent of intention and behaviour. In addition, the findings provide further evidence for the existence of a ‘value-action’ gap, or a gap between beliefs and behaviour, evident in other environmental behaviour studies (Stern, 2000; Jackson, 2005; Darnton *et al.*, 2006; Chung & Leung, 2007). The often weak translation of intention into behaviour suggests the presence of strong contextual factors that shape agency in the South African waste sector, particularly in public waste organisations. The research supports the findings of Gardner and Stern (1996:92), in that data and knowledge can only influence behaviour when the “*main barriers to action are internal to the individual.*”

Chapter 7 therefore set out to explore these societal forces that shape behaviour by means of the collection of qualitative data. Since societal structures are hidden systems that determine human agency, it is not always possible to identify and measure them directly and quantitatively (Johnston, 1986). In structuration theory it is assumed that the ‘surface features’, such as the barriers, are visible and that the structures need to be analysed and inferred from them (Johnston, 1986; Peet, 1998). Therefore, the influence of the underlying societal structures on behaviour was examined by drawing inferences from the barriers to good waste management practice as experienced by respondents. The evidence shows that economic and political structures currently do impact on the behaviour of respondents in participating waste organisations. Particularly evident are the strong competing tensions between the neoliberal capitalist economy and the mandate for political, legislative and organisational transformation which is occurring in response to the post-1994 political structures. These tensions are experienced more directly by respondents in municipalities. The results show that these societal structures do impact upon the ability of respondents to implement good waste management practice, by shaping the underlying beliefs of individuals and ultimately their intentions and behaviours. However, the structures also create social and organisational barriers which

constrain agency, often resulting in low volitional control. The influence of societal forces on waste behaviour, evident from the research presented in **Chapters 6 and 7**, supports the early findings of Godfrey & Scott (2011) (**Chapter 3**) of the existence of external forces and resultant barriers to waste data collection and utilisation.

The conceptual model of the knowledgeable, situated actor (**Figure 8-1**) is shown to be a useful framework for understanding the influence of waste data in building knowledge and in shaping individual waste behaviour, but more importantly for understanding how societal structures contextualise and constrain this individual waste behaviour within public and private waste organisations in South Africa. This is important to recognise, as any interventions put in place which emphasise waste data or capacity development as mechanisms for improving waste management, may not have the desired outcome without also addressing interventions at the organisational and societal levels.

8.4. Theoretical and methodological contributions

8.4.1. Novel contribution to the theory of waste management in a developing country

The final conceptual model of the knowledgeable, situated actor (**Figure 8-1**) has provided a unique theoretical framework for addressing the research question and sub-questions related to waste management in South Africa. The conceptual model has been developed through a process of critically applying a range of theory to empirical data in order to understand the research questions. The process of inductively constructing this model has been driven by the research question, sub-questions and research findings within a pragmatic paradigm.

The initial theory of the process of learning (Miller & Morris, 1999) was found to be suitable for assessing the influence of data on knowledge, but was found to be insufficient for assessing the influence of data on behaviour, and for understanding the influence of factors external to the individual in the process of constructing knowledge. When combined with Ajzen's (1985) theory of planned behaviour, the combined theoretical framework of learning-behaviour provided an elegant means of assessing the influence of data on beliefs, intention and behaviour. However, again, the linear, atomistic framework was not able to explain the influence of the societal context on individual behaviour. An understanding of this influence was achieved by embedding the framework within structuration theory (Giddens, 1984), which allowed the researcher to probe the broader social, economic and political structures that shape behaviour and which create barriers to action.

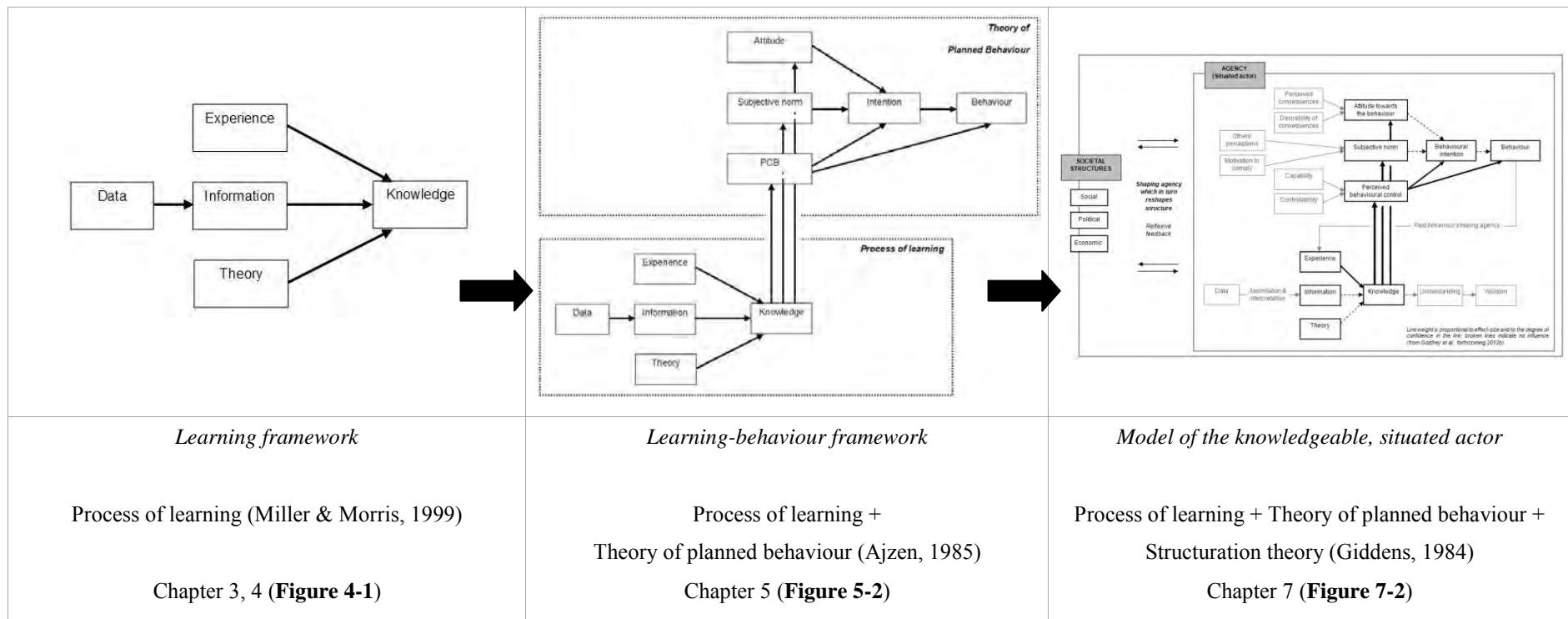


Figure 8-1. Process of inductively building a theoretical framework as final conceptual model of the knowledgeable, situated actor.

It is recognised that the model has been built from three theories, each of which are based on approaches with different and competing epistemological, ontological, and methodological assumptions. However, adopting a pragmatic approach to this research has allowed the author to construct a novel, conceptual model which has been successful in addressing the research questions; provided a deeper understanding of societal context and waste management in South Africa; and identified practical solutions to improve waste management. A literature search has revealed that such a holistic model of the situated actor has not been applied to the waste sector, and certainly not in understanding the influence of data on knowledge and behaviour within a developing country context such as South Africa. This conceptual waste model of the knowledgeable, situated actor is felt to be a contribution to the body of literature on waste management in developing countries in general, and in the management of waste in South Africa, in particular.

In addition to the above theoretical contribution, the research has also contributed to theoretical ideas related to particular constructs within the behavioural theories. This is discussed below.

8.4.2. Contribution to behavioural theory in a developing country

This research set out to work in the field of waste management. However, having drawn strongly upon current thinking in the fields of environmental psychology, environmental education, and science communication, the research findings also provide a theoretical contribution back to these fields, as discussed below.

8.4.2.1. *Inductive and deductive subjective norms*

As discussed in some detail in **Chapter 5** (Section 5.4.4.2), there has been a move in the literature to include both injunctive and descriptive subjective norms in the application of the theory of planned behaviour (Klein & Boster, 2006; Dohnke *et al.*, 2011). Injunctive norms refer to what other people think we should or should not do, while descriptive norms refer to what other people actually do (Klein & Boster, 2006). The South African context, as shown through this research, creates a risk that these constructs might be measuring different things, due to the large disparity in waste operations. The difference in what others ‘think’ (injunctive) and ‘do’ (descriptive) has the potential to cause multi-dimensionality in the subjective norms construct, which can weaken the apparent contribution of subjective norms to intention. Although including both injunctive and descriptive norms allows for a broader conceptualisation of social norms, future application of this conceptual waste model must bear potential multi-dimensionality in mind, and monitor for potential attenuation.

8.4.2.2. *Past behaviour and Perceived behavioural control*

The theory of planned behaviour has been criticised for not including past behaviour as a predictor of current behaviour. Many researchers have included past experience as an additional construct to the theory of planned behaviour and in so doing increased the variance in behaviour explained by the model (**Chapter 5**, Section 5.5.2.4). The results of this research, and the development of a modified learning-behaviour theoretical framework, suggest that past behaviour is already accommodated in the theory of planned behaviour within the construct of perceived behavioural control. Past behaviour can be equated to experience, which has been shown here to have a significant influence on behaviour, via the ‘knowledge’ and ‘PBC’ constructs. Including past experience as a separate predictor of behaviour could therefore result in a double contribution to the explained variance in behaviour. This should be tested for in future.

8.4.3. Mixed-methods and sub-populations

The results obtained from the application of the two linear, atomistic theories (**Chapters 4 and 5**) were shown to be highly dependent upon the nature of the sample and the presence of sub-groups. Early statistical analysis of the quantitative data missed the presence of sub-groups within the sample, and therefore did not detect differences in the construction of knowledge and behaviour within the sample. It was only through open discussions with respondents and the analysis of the qualitative data, that the presence of sub-groups for different organisation types was suspected. This supposition was then tested for statistically using the pathmox algorithm, which confirmed the existence of two local models, for public and private waste organisations. Only through the collection and analysis of both qualitative and quantitative data was it possible to detect the presence of these sub-groups and to identify differences in the way knowledge and waste behaviour are constructed for respondents within the sub-groups. The presence of sub-groups, and the behaviour within these groups, may therefore have been hidden if a mixed-methods research approach had not been applied, and if the sample had been treated as a single, homogenous group. The application of the theory of planned behaviour therefore has the potential to give different results depending on the nature of the sample and sub-groups.

The behaviour of respondents has been shown in this research to be influenced by the societal context. The theory of planned behaviour has mostly been successfully applied in developed countries (Oom Do Valle *et al.*, 2005; van Birgelen *et al.*, 2009). This research has shown that the theory of planned behaviour is also relevant in developing countries. However, the research has provided a valuable contribution by highlighting the importance of societal context in the application of these linear, atomistic theories. Perceived behavioural control, for example, may

be more relevant in predicting behaviour than intention in developing countries where societal context plays an important role in shaping behaviour.

8.5. Recommendations

According to Mosler *et al.* (2008:539) “*focus should be shifted from purely theoretical model-testing toward developing models for the practical realization of interventions. The theories and models must therefore be useful and practical for developing interventions and not overly general or sophisticated.*” As discussed in Chapter 7, South Africa, as a developing country, has undergone rapid political, legislative and organisational transformation in the public and private sectors following the establishment of a democracy in 1994. These changes have influenced the way in which waste is managed. While pockets of best practice exist in the management of waste in South Africa, there are many waste facilities that are non-compliant and have the potential to cause environmental and human health risks. At this stage in the country’s development, it is therefore important that research not only provide theoretical contributions but also provide practical interventions, which can improve the way waste is managed. The following section puts forward practical recommendations for improved waste management based on the findings of this research.

8.5.1. Policy implementation

First, it is important that the regulations requiring reporting to SAWIS, gazetted in May 2009 for public comment, be enacted as soon as possible to enforce reporting of data by all identified waste landfill sites, treatment facilities and waste reprocessors. In so doing, it will create a new set of rules at the societal level, which has been shown in this research to support respondents in implementing good waste management practice. It will provide valuable data across the three spheres of government to assist with waste planning and decision-making, assuming that the data is correctly and accurately captured. It will also increase the number of organisations reporting to SAWIS which will be beneficial for future assessments using the conceptual model. Finally, more organisations reporting to SAWIS will greatly increase the potential for learning from this data by respondents in participating organisations.

Changes to operational and administrative policy particularly in municipalities, needs to be revisited in order to address issues such as budgets, authority to make decisions, and outsourcing of operations. These policy changes can only be of benefit to waste management in South Africa.

8.5.2. Identifying ‘weak points’ that require waste management interventions

Second, reflecting on the five most widely accepted behavioural theories (**Chapter 5**); the three dominant factors required for producing any behaviour include the possession of the necessary *skills* to perform the behaviour; a strong positive *intention* to perform the behaviour; coupled with the removal of environmental *barriers* that inhibit the behaviour. These three factors coincide with each of the stages of development of the conceptual model. The conceptual model therefore provides a practical framework for identifying areas of operational weakness and where practical recommendations for improved waste management are required. It is recommended that those initiatives and programmes that are working be identified and strengthened, and areas where new interventions are required be identified.

The following three sections provide practical recommendations in an effort to increase current waste management skills of personnel in public and private waste organisations; support the translation of intention into actual waste behaviour; and to remove barriers to action.

8.5.2.1. Waste management skills

Much of this research has focussed on the construction of waste knowledge, and the existing waste skills within public and private waste organisations. Given the concerns raised by respondents around the lack of waste knowledge particularly in municipalities, and the growing demand for specialist technical waste skills in South Africa, the following interventions are recommended:

- Further development of formal waste training programmes to provide a body of *theory* related to waste management. These training programmes need to be pitched at varying levels of skill from e.g. the waste collectors (skill level 1 or 2) to the waste facility engineer (skill level 5). A number of opportunities exist for implementation of such training programmes, through NGOs and professional associations (e.g. IWMSA), to university curricula. However, it is recommended that these training programmes align with human capital development (HCD) initiatives being planned by the Department of Environmental Affairs (DEA, 2010), and the Department of Science and Technology (DST). The DEA and DST have recognised the need for “*re-skilling across the board to a new waste management paradigm*” in response to new waste legislation (DEA: 2010:1) and the development of waste innovation capacity in support of the Green Economy (DST, 2007).
- Strengthen experiential training programmes and access to mentors in order to provide a richer source of *experience* for waste workers. The results have shown the importance of experience in building knowledge, and the importance of mentors in developing this

experience. Evidence from this research has shown that there are growing concerns around access to skilled mentors, particularly within municipalities. Opportunity therefore exists for the development of waste skills through the implementation of formal and informal experiential training programmes. This also means recognising the role that consultants, contractors and service providers play in educating current waste management practitioners, and the value of having access to skilled mentors through the outsourcing of certain waste functions. More can certainly be done along the lines of the Engineering Council of South Africa's (ECSA) initiatives of involving retired engineers to mentor young professionals in municipalities (Seggie, 2011)

- Educate SAWIS users on the potential impact of SAWIS *data* on waste operations. Given that reporting to SAWIS will soon be enforced through waste information regulations (once promulgated), there is much still to be done around educating SAWIS users of the potential uses of waste data – both within the submitting waste organisations, as well as within the receiving provincial and national government departments. The research shows that data has the potential to contribute to knowledge generation and resultant behaviour, however, much more education needs to happen with regards to the potential operational uses of this data. Since DEA is the custodian of SAWIS, these data awareness and education programmes need to be driven by national government.

8.5.2.2. *Intention to improve waste management*

The weak contribution of *attitude* and social pressure (*subjective norms*) to intention, particularly for respondents in municipalities, can be addressed through the following:

- Government must place a stronger emphasis on legislative compliance of all waste organisations (public and private), but particularly municipalities. This will create a sense of consequence and help to develop a strong organisational culture towards good waste management practice. In this way we strengthen the *attitude* of waste officers and senior managers towards good waste management practice.
- Strong communication programmes from government and non-governmental organisations, especially aimed at municipalities, that good waste management practice is important to government. More can also be done by government to benchmark current waste practices between organisations. This will highlight what others are doing and where good waste management practices are currently being implemented. Raising the importance of good waste management practices to government and highlighting where others are currently implementing such practices, will strengthen people's *normative beliefs*.

Private waste organisations need to continue to develop the strong organisational culture towards compliance and good waste management practice evident in this case study, despite the potential to let this weaken in response to economic pressures and cost savings.

8.5.2.3. Barriers to good waste management practice

Barriers were shown to be a significant factor in shaping waste behaviour, in that they often impact upon the intention of those tasked with the responsibility of managing waste, particularly respondents in municipalities.

Barriers can be addressed by either removing the barrier, or by looking for innovative ways to work within or around the barriers. However, as shown in this research, many of these barriers are not created within the waste sector, but are instead the product of broader societal and organisational structures. While mechanisms can be put in place within the organisation to reduce the impact of these barriers, solutions must also be sought outside of the waste sector. Recognising that the failures in waste management are a function of the broader societal structures, conceptualising waste management at a societal level can help to reduce the frustrations experienced by respondents, particularly within municipalities. It is therefore important for waste officers to locate their own practices within this broader societal context. However, these barriers and societal structures should never be used as an excuse for not trying to change the way waste is managed.

Certain of the identified barriers, such as funding, resources, and knowledge, can be addressed through skills development, attitude and social pressure, discussed above. Further areas of intervention to address issues such as political interference, government bureaucracy, slow decision-making and authority, include:

- Streamlined administrative and procurement policies within government to enable effective and quick implementation of decisions. This includes a transfer of accountability, together with responsibility, to the most appropriate level of decision-making.
- Outsourcing of waste operations needs to be considered more actively by government and unions, particularly where a better technical and a cheaper service can be provided. Outsourcing can free up municipal funds to be redirected into other municipal developmental functions, if done correctly.

Through interpretation of the conceptual model, it is posited that by addressing the above issues, we can create an environment conducive for individual action and resultant improved waste management in South Africa.

8.6. Future research

It is recommended that similar research on the influence of data on knowledge and behaviour be undertaken in the future, when the SAWIS population has increased to a number that will allow for the application of more in-depth quantitative research methods. This will provide further confidence in the results obtained in this study. An increased SAWIS population in the future will also allow analysis of whether two sub-groups exist within the private waste local model, a sub-group for private industry and for private waste companies. This could not be determined in this study with any degree of confidence. The conceptual model developed here provides a useful theoretical framework to guide such future research.

Furthermore, while the influence of waste data/information, experience and theory on knowledge was assessed in this study, the *quality* of this waste knowledge was not assessed. It is possible, for example, that while experience is currently the single greatest contributor to the generation of waste knowledge, weak experiential learning could result in a weak knowledge base, or in the generation of incorrect knowledge.

The conceptual model also provides a framework from which to monitor the success of future interventions which may be implemented in response to the recommendations made in Section 8.5.

8.7. Conclusions

This research has addressed the research question ‘*Can the collection of data for a national waste information system, change the way waste is managed in South Africa, such that there is a noticeable improvement?*’ The research was conducted over a six year period (2005-2011) making use of a mixed-methods research design. Drawing on different theories and methods from different scientific disciplines with different philosophies, and placing this research within a pragmatic paradigm, has provided a fuller understanding of the role of waste data in a developing country such as South Africa.

The results show that currently waste data does not have a significant direct or indirect effect on waste behaviour. However, the conceptual model of the knowledgeable, situated actor, developed through the course of this research, shows that data has the potential to influence behaviour by influencing knowledge, beliefs and intention. Where contextual factors are weak, as in the case of many private waste organisations, data, resultant knowledge and beliefs, have the potential to influence waste behaviour. Where contextual factors are strong, as in many

municipalities in South Africa, these barriers interfere with the intentions of waste officers.

The conceptual model provides a valuable tool for modelling and understanding waste behaviour in South Africa. It also provides a structured approach to identify areas that require intervention and that will lead to an improvement in the way waste is managed.

The South African waste information system has the potential to be more than just a repository of historical data on the tonnages of waste landfilled, treated and recycled in the country. The collection of data for SAWIS has the potential to generate new waste knowledge and through this new knowledge, positively change the behaviour of those responsible for managing waste in South African public and private waste organisations.

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ANNEXURE 1

Questionnaire 1
October / November 2006

WASTE INFORMATION SYSTEM NEEDS ANALYSIS QUESTIONNAIRE ⁽¹⁰⁾

The following questions have been drafted to allow members of local and provincial government the opportunity to provide input into the needs analysis programme of the South African Waste Information System project.

Name: **Position:**

Local Authority name: or

Provincial Department name:

Tel: **Fax:** **Email:**

SECTION 1

This section is aimed at capturing the status quo with respect to information on waste in your municipality or Province

Waste Data

Does your Department / Directorate have data on waste within your area of jurisdiction (e.g. list and location of generators, transporters, landfills, or types and quantities of waste generated, landfilled, treated)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------	-----------------------------

If yes, very briefly describe (i) what data you have and (ii) who provides this data

.....

Is this waste data reliable and up to date?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
---------------------------------------------	------------------------------	-----------------------------

If yes, very briefly describe (i) how often this data is collected

.....

What is this data used for?

.....

How is this data stored?

<input type="checkbox"/> Reports	<input type="checkbox"/> Paper / Filed	<input type="checkbox"/> Spreadsheet	<input type="checkbox"/> Database / Information System
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Has your Department / Directorate developed (or are developing) an Integrated Waste Management Plan (IWMP)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
-------------------------------------------------------------------------------------------------------------	------------------------------	-----------------------------

If yes, was there adequate data available to inform the IWMP?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
---------------------------------------------------------------	------------------------------	-----------------------------

⁽¹⁰⁾ This questionnaire has been shortened in length for the purposes of inclusion in this paper. While no questions have been removed, the space provided for answers has been reduced.

If yes, who is developing the IWMP?	<input type="checkbox"/> Self	<input type="checkbox"/> Consultant
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How is your Department / Directorate currently planning or making decisions around waste management activities? Are you basing decisions on:

<input type="checkbox"/> obvious waste problems	<input type="checkbox"/> educated guesses
<input type="checkbox"/> what you perceive to be strategic issues	<input type="checkbox"/> commissioning of waste investigations by consultants
<input type="checkbox"/> what provincial or national government identifies as strategic issues	<input type="checkbox"/> available, reliable waste data

Information Systems

Does your Department / Directorate have any environmental information systems in place?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
-----------------------------------------------------------------------------------------	------------------------------	-----------------------------

If yes, what environmental data are you collecting?

.....

Does your Department / Directorate have a Waste Information System (WIS) in place?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
------------------------------------------------------------------------------------	------------------------------	-----------------------------

If No to Question 11, please complete Section 2 of this Questionnaire.
 If Yes to Question 11, please complete Section 3 of this Questionnaire.

SECTION 2

This section is aimed at capturing your requirements or expectations of a local or provincial WIS? (**Note:** It is important to convey your actual waste information needs rather than a 'wish list' !)

Would your Department / Directorate need access to a WIS?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
-----------------------------------------------------------	------------------------------	-----------------------------

If yes, very briefly describe (i) Why you would need access to a waste information system

.....

What waste information do you require to support *strategic* planning or decision-making?

.....

Who should provide this information to you?

.....

Who should keep and maintain this information?

.....

Does your Department / Directorate have any plan to develop and implement a WIS within the next year?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
-------------------------------------------------------------------------------------------------------	------------------------------	-----------------------------

If yes, very briefly describe when and how the system will be developed

.....

Has your Department/Directorate made financial provisions in the IDP, IWMP, Business Plan for the collection of waste data or the development of a WIS?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
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SECTION 3

This section is aimed at capturing your learning if a Provincial or Local Authority Waste Information System is being/or has been developed.

Is your WIS currently operational, i.e. are you collecting and storing waste data in the system?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
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If not, very briefly describe (i) Why the system is not operational

.....

What data is (will be) reported to the WIS?

.....

Who reports (will report) to the WIS and when?

.....

Who has (will have) access to the WIS and data in the WIS?

.....

What software system/platform was (will be) utilised for development?

.....

What is (will) the data be used for, i.e. what were the objectives of developing a system?

.....

Who manages (or will manage) the WIS?

.....

Is reporting to the WIS?	<input type="checkbox"/> Enforced through Regulations	<input type="checkbox"/> Voluntary
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What lessons were learnt in the development and operation of the system?

.....

What are/were the critical problems encountered in development?

.....

Has your Department/Directorate made financial provisions in the IDP, IWMP or Business Plan for the collection of waste data / development of a WIS?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
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** If you have any additional, general comments, please feel free to add these in your response.

Feedback on these questions will be used to draft a report on the needs analysis and current status of waste information systems in South Africa. The report will assist in developing the framework for the National Waste Information System to be developed and rolled out during 2005-2006.

ANNEXURE 2

Questionnaire 2
April / May 2011

I have been informed about the purpose of this study (cover letter) and I participate voluntarily on an anonymous basis.

Date of interview: _____ Time: _____

PART 1: QUESTIONNAIRE¹¹

SECTION A: BACKGROUND INFORMATION

1. Gender	<input type="checkbox"/> Male	<input type="checkbox"/> Female								
2. To which population group do you belong?	<input type="checkbox"/> Black	<input type="checkbox"/> White	<input type="checkbox"/> Indian/Asian	<input type="checkbox"/> Coloured						
3. Into which age group do you fall?	<input type="checkbox"/> 20 – 29	<input type="checkbox"/> 30 – 39	<input type="checkbox"/> 40 – 49	<input type="checkbox"/> 50 – 59	<input type="checkbox"/> > 60					
4. For what type of organisation do you work?	<input type="checkbox"/> Public	<input type="checkbox"/> Private								
5. What is your current position within the organisation?	<input type="checkbox"/> Admin office	<input type="checkbox"/> Waste information officer	<input type="checkbox"/> Waste officer	<input type="checkbox"/> Middle management	<input type="checkbox"/> Senior management	<input type="checkbox"/> Other				
6. What is your <u>role</u> in the organisation when it comes to SAWIS waste data? I ...	<input type="checkbox"/> Collect the raw waste data	<input type="checkbox"/> Capture waste data on computer	<input type="checkbox"/> Analyse the waste data	<input type="checkbox"/> Submit waste data to SAWIS	<input type="checkbox"/> Prepare reports from the data	<input type="checkbox"/> Use the waste data	<input type="checkbox"/> Review only the data	<input type="checkbox"/> No role	<input type="checkbox"/> Other	
7. What types of waste facilities does your organisation operate?	<input type="checkbox"/> Landfills	<input type="checkbox"/> Recycling	<input type="checkbox"/> Treatment (thermal)	<input type="checkbox"/> Treatment (Non-thermal)						
8. Is your organisation ISO certified (e.g. ISO 14000, ISO 9000)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know							
9. Is your organisation part of a large multinational organisation and have an international parent company?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know							
10. How long have you worked for your current organisation ?	<input type="checkbox"/> < 1year	<input type="checkbox"/> 1-2 years	<input type="checkbox"/> 2-4 years	<input type="checkbox"/> 4-6 years	<input type="checkbox"/> 6-8 years	<input type="checkbox"/> 8-10 years	<input type="checkbox"/> > 10 years	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

¹¹ Note that the order of the questions given here are not the same as the order of questions in the administered questionnaire. Questions testing the same construct were interspersed throughout the questionnaire in the administered version, so as not to create response biases.

11. How long have you worked in your current job at this organisation?

< 1year 1-2 years 2-4 years 4-6 years 6-8 years
 8-10 years > 10 years

Current level of waste education, experience

12. Education: What is your highest level of education ?

Some high school Matric / Grade 12 Artisan's certificate
 Technikon diploma completed University degree completed Post-graduate degree completed (Hon, Masters)
 Other

13. If you have a degree/diploma, what do you have, e.g. BEng, BSc ?

14. If yes, to 13, what were your major subjects ?

15. Waste experience: How many years of working waste experience do you have?

<1 year 1-2 years 2-4 years 4-6 years 6-8 years
 8-10 years 10-15 years 15-20 years >20 years

16. *To what extent do you agree/disagree with the following statement: "My work colleagues (in the waste/SHEQ department) are knowledgeable on waste issues"*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

17. How would you rate your technical waste knowledge?

Poor	1	2	3	4	5	6	7	Excellent
------	---	---	---	---	---	---	---	-----------

18. How would you rate the current level of waste management in your organisation

Poor Fair Good Excellent

Process of learning

19. *To what extent do you agree/disagree with the following statement: "I have built my waste knowledge mostly through practical experience on waste projects"*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

20. *To what extent do you agree/disagree with the following statement: "Working on real waste projects has been an important way of learning about waste management"*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

21. *To what extent do you agree/disagree with the following statement: "I have built my waste knowledge mostly through collecting and analysing waste data "*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

22. *To what extent do you agree/disagree with the following statement: “Collecting waste data has been an important way of learning about waste management for me.”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

23. *To what extent do you agree/disagree with the following statement: “I have built my waste knowledge mostly through courses / training / degrees”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

24. *To what extent do you agree/disagree with the following statement: “Studying and attending courses has been an important way of learning about waste management for me”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

SECTION B:

Each question in this section refers to measuring “**good waste management practice in your organisation**”. **GOOD WASTE MANAGEMENT PRACTICE** is defined for the purposes of this study, as waste activities that -

- Are compliant with waste and environmental legislation, e.g. permitted facilities, operated according to full permit conditions, and regularly audited and monitored
- Promote the waste hierarchy and support waste avoidance, minimisation, reuse and recycling
- Minimise the impact of waste and possible pollution on the receiving environment and on human health

Influence of knowledge on beliefs

25. *To what extent do you agree/disagree with the following statement: “Building my waste knowledge has made me more aware of the consequences of not implementing good waste management practices in my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
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26. *To what extent do you agree/disagree with the following statement: “Because of my knowledge on waste issues I am more aware of why we should implement good waste management practice in my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
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27. *To what extent do you agree/disagree with the following statement: “My colleagues (in the waste/SHEQ department) are building their waste knowledge which is making them more aware of the consequences of not implementing good waste management practices in my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

28. *To what extent do you agree/disagree with the following statement: “Because my colleagues (in the waste/SHEQ department) are knowledgeable on waste issues they are more aware of why we should implement good waste management practice in my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

29. *To what extent do you agree/disagree with the following statement: “Building my waste knowledge has made me more capable of implementing good waste management practices in my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

30. *To what extent do you agree/disagree with the following statement: “Building my waste knowledge has given me more control over implementing good waste management practices in my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

Theory of planned behaviour

Normative beliefs (Attitude)

31. For me to implement good waste management practices in my organisation , is

Unimportant	1	2	3	4	5	6	7	Important
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32. For me to implement good waste management practices in my organisation , is

Responsible	1	2	3	4	5	6	7	Not responsible
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33. For me to implement good waste management practices in my organisation , is

Bad	1	2	3	4	5	6	7	Good
-----	---	---	---	---	---	---	---	------

34. *To what extent do you agree/disagree with the following statement: “Implementing good waste management practices within my organisation would have positive environmental and social consequences ”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

Subjective Norms

Injunctive

35. *To what extent do you agree/disagree with the following statement: “The people who are important to me think that I should implement good waste management practices in my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

36. *To what extent do you agree/disagree with the following statement: “It is expected of me to implement good waste management practices within my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

Descriptive

37. *To what extent do you agree/disagree with the following statement: “Other organisations like mine are implementing good waste management practices”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

38. *To what extent do you agree/disagree with the following statement: “The people who are important to me in this organisation implement good waste management practices”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

39. *To what extent do you agree/disagree with the following statement: “My colleagues (in the waste/SHEQ department) implement good waste management practices within my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

40. *To what extent do you agree/disagree with the following statement: “My organisation places a strong emphasis on good waste management practices within the organisation*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

41. *To what extent do you agree/disagree with the following statement: “The National Department of Environment places a strong emphasis on good waste management practices within my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

Perceived behavioural control

Capability / Self-efficacy

42. *To what extent do you agree/disagree with the following statement: “I am sufficiently knowledgeable to implement good waste management practices in my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

43. *To what extent do you agree/disagree with the following statement: “Applying my waste knowledge will make a difference in implementing good waste management practices in my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

44. *To what extent do you agree/disagree with the following statement: “I am capable of implementing good waste management practices in my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
-------------------	---	---	---	---	---	---	---	----------------

Controllability

45. For me to implement good waste management practice in my organisation would be?

Easy	1	2	3	4	5	6	7	Difficult
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46. *To what extent do you agree/disagree with the following statement: “I am confident that I can personally contribute to changing the way waste is managed in my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
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47. *To what extent do you agree/disagree with the following statement: “It is within my power to implement good waste management practices in my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
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48. *To what extent do you agree/disagree with the following statement: “There are strong barriers within my organisation that make it difficult to implement good waste management practices”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
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49. *To what extent do you agree/disagree with the following statement: “I have the authority to implement good waste management practices in my organisation”*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
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50. *To what extent do you agree/disagree with the following statement: "I have the responsibility to implement good waste management practices in my organisation"*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
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Intention

51. *To what extent do you agree/disagree with the following statement: "I intend to implement good waste management practices in my organisation"*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
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52. I always try to implement good waste management practices in my organisation

Definitely false	1	2	3	4	5	6	7	Definitely true
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Behaviour

53. *To what extent do you agree/disagree with the following statement: "I implement good waste management practices in my organisation"*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
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54. In my organisation I implement good waste management practices
(Tick one of the following boxes)

- Never
- Almost never
- Seldom
- Sometimes
- Often
- Almost always
- Always

55. How would you rate current waste management practices in your organisation?

Poor	1	2	3	4	5	6	7	Best practice
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Data to behaviour

56. *To what extent do you agree/disagree with the following statement: "Collecting waste data within my organisation has had a positive impact on the way we manage waste"*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
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57. *To what extent do you agree/disagree with the following statement: "Collecting waste data, specifically for reporting to the SAWIS, has a positive impact on the way our organisation manages waste"*

Strongly disagree	1	2	3	4	5	6	7	Strongly agree
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THANK YOU FOR YOUR PARTICIPATION
THIS SECTION IS NOW FOLLOWED BY 11 OPEN ENDED QUESTIONS FOR DISCUSSION

PART II: INTERVIEW SCHEDULE

Open-ended questions for discussion

58. Was your organisation collecting waste data before it was required for SAWIS, and if yes, for what reason were you collecting data?
59. In your opinion, has anything changed in the way your organisation manages its waste because of data collection, and more specifically data collection for SAWIS?
60. In relation to **Question 48** above, “In your experience what are the top **three** barriers within your organisation to implementing good waste management practices?”, could you tell me about these
- a.
 - b.
 - c.
61. Can you give me an example, from your own experience, of one of the above three “barriers” that stopped you from implementing good waste management practices in your organisation?
62. In relation to your above answers, “to what extent do you think that these barriers apply in other (municipalities / private waste companies) (See also Question 33)?”
63. You (agreed / disagreed) with [**Question 38**] that “People who are important to you think that you should implement good waste management practices in my organisation”. Why do you feel that way?
64. In relation to **Question 55** above, “Why do you think it would be (Difficult / Easy) to implement good waste management practices in your organisation?”
65. Has it become (easier / more difficult) for you to implement good waste management practices in your organisation in the past 5 years? Give reasons for your answer
66. Why do you (agree / disagree) [**Question 24**] that collecting data within your organisation has a positive impact on the way your waste is managed?
67. What do you feel have been the **three** most significant activities / events / experiences in your career that have contributed to your current waste knowledge
- a.
 - b.
 - c.
68. What have you personally learnt about waste management in your organisation from the waste data that you are collecting for SAWIS?

ANNEXURE 3

Conference papers prepared in support of PhD

The importance of information system design improvisation in meeting the needs of an emerging democracy in South Africa, a case study of a national waste information system

Linda Godfrey¹²

Proceedings: EnviroInfo 2006, 20th International Conference on Informatics for Environmental Protection, 6–8 September 2006, Graz, Austria

Abstract

Designing a successful national waste information system (WIS) for an emerging democracy in South Africa requires that the system be relevant, efficient, effective and above all sustainable. To do this, the needs of government and stakeholders and the opportunities and constraints which face government and industry, need to be understood. The design methodology needs to consider these needs, opportunities and constraints to ensure that the risk of system failure, whether total or partial is reduced. The identified needs, opportunities and constraints are further explored and an approach to reduce the design-actuality gap proposed.

1. Introduction

South Africa emerged as a democratic society in 1994, following the abolishment of apartheid. The past ten years have seen both a significant growth in environmental policy within the country, as well as a positive change in the approach towards environmental management. The South African Department of Environmental Affairs and Tourism (DEAT) published a White Paper on Integrated Pollution and Waste Management (IP&WM) in 2000 (DEAT, 2000) which outlined “*government’s new thinking in relation to pollution and waste management*”. The policy (goal 6) identified the need to develop and maintain databases and information management systems, to monitor and collect information on pollution, chemical hazards, toxic releases, transportation of hazardous materials and waste generation. The intent being to support the implementation of pollution and waste reduction measures, effective integrated pollution and waste management, and the constitutional rights of all South Africans through access to information (Act 108 of 1996, Act 2 of 2000).

In 1999, the development and implementation of a waste information system (WIS) was costed at R21 million (\$3.6 million) (development and investment costs), with an annual operating cost of R57 million (\$9.7 million) (DEAT, 1999). The staff requirements to implement the WIS were given as ~370-850 persons solely within government. No figures were given as to the staff requirements within the companies responsible for providing the data, but with an estimated 200 000 data providers to the WIS (DEAT, 1999), the capacity required within the waste industry, and the associated cost, is daunting.

A prototype system was developed and piloted in 1999, but was never implemented. Implementation lay dormant for five years (1999-2004). Possible reasons include the high

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turnover of government officials following the development of the policy or the lack of ownership of the policy by government due to the heavily consultant driven approach adopted by the donor funded project.

A donor funded project was again initiated in 2004 (DEAT, 2004) to develop and implement a sustainable, national WIS for South Africa, a system capable of routinely collecting accurate data on waste, across three spheres of government and from various waste industry role-players. This in light of government's previous, unsuccessful, attempt to develop and implement a sustainable WIS.

2. System sustainability

Information system failure is not unique to South Africa. Nor is it unique to other developing countries or even to developed countries. In fact developed countries show up to a 50-85% partial or total failure rate of information systems (Heeks, 2002). Developing countries do however show a comparatively higher failure rate than that experienced by developed countries (Heeks, 2002; Peterson, 1998) due to a lack of appropriate technical and human infrastructure (Heeks, 2002; Moussa & Schware, 1992), limited management capacity and commitment (Peterson, 1998), high government staff turnover (Moussa & Schware, 1992), an unsupportive public sector culture (Mursu et al., 2000; Peterson, 1998), post development withdrawal of donor funds (Heeks, 2002), and adoption of often overly complex (Peterson, 1998) or unsuitable industrialised country information systems (Heeks, 2002; Odedra, 1993). According to Peterson (1998:38), "*Information systems fail or underperform more often than they succeed in the public sector in Africa*" primarily because "*they outstrip the capacity of government staff to manage. The management task is formidable.*"

Heeks (2002:104) proposes that these system failures are as a result of a "*mismatch between local actuality (where we are now) and system design (where the design wants to get us)*", what he terms as the '*design-actuality gap*' (Heeks, 2002) or the '*design-reality gap*' (Heeks, 2005). The greater the gap between the proposed system design and reality, the greater the change required to close the gap, the greater the risk of failure of the information system (Heeks, 2002) and the greater the potential for conflict between users and stakeholders (Warne, 2003).

According to Peterson (1998:38), "*The objective of systems development is the creation of a useful and sustainable information system.*" With the previous failure to implement a WIS in South Africa, system sustainability⁽¹³⁾ was a critical aspect to consider in the design and development – an aspect which needed to be considered not at the end of the project, but importantly during design and development.

3. Identifying the design-reality gap (needs, constraints and opportunities)

The development of a sustainable WIS required a framework or system design which had the support and buy-in of both government and key stakeholders. The preparation of such a system design therefore required an understanding of the current 'philosophy' of government and stakeholders with respect to the WIS, the needs of government with respect to waste information, and the issues which stood in the way of successfully developing and implementing a sustainable waste information system in a developing country such as South

¹³ Sustainability is seen as being the "*the ability of a programme or project to continue, and to continue being effective, over the medium to long-term*" (UNAIDS, 2005).

Africa. The design process needed to clearly understand both the “*local actuality (where we are now) and system design (where the design wants to get us)*” (Heeks, 2002:104), so as to identify critical gaps which could potentially undermine system sustainability.

In order to quantify these needs, constraints and opportunities a participative approach involving all end users (government and the waste industry), community based organisations (CBOs), non-governmental organisation (NGOs) and specialist consultants was adopted. The ‘gap’ between reality and design could be identified in terms of the constraints which stood in the way of successful system development and implementation, and the opportunities could be identified as those aspects where little gap existed and on which the system design could be founded.

3.1 Understanding the needs

Moussa and Schwere (1992) in a study of information systems in Africa found that for 29% of systems, the intent or purpose of the information system was unclear, and for 27%, the systems were not relevant to the organisational objectives. These problems relate to the lack of a clear understanding of the needs of the relevant stakeholders. A problem recognised as being one of the top three reasons for information system failure (Schmidt et al., 2001; Axtell et al., 1997 in Fisher, 2003).

Two parallel processes were adopted for assessing the needs of stakeholders, (i) workshops were held in selected provinces and (ii) a postal questionnaire was sent out to all 284 local authorities.

The top needs of government with respect to the national WIS, as identified from this participative process (Godfrey, 2006), were to (i) inform waste management *planning*, (ii) support *compliance/enforcement* by government, (iii) support public *access to information*, (iv) inform *decision-making*, (v) inform *policy development*, (vi) inform *new development* initiatives, (vii) support *human resource & operations management*, (viii) inform *budgeting/billing/financial management* of waste operations.

The needs analysis recognised that an improvement in the management of waste was required, and that to do this a change in the way government and industry addresses waste was necessary. This change could be facilitated through the successful implementation of a national WIS.

3.2 Understanding the constraints

With these needs in mind, the constraints to successfully developing and implementing a WIS in South Africa were explored through workshops with selected provincial and local governments. In terms of Heeks’ design-reality gap model (Heeks, 2002; Heeks, 2005), a constraint is seen as a gap between the current state or ‘*reality*’ and the desired state or ‘*design*’. Understanding the constraints therefore assists in identifying critical gaps which may undermine successful system implementation.

The key constraints to development and implementation of a WIS within government and industry were identified as a (i) *lack of high-level political and management support* within government to develop and/or implement the WIS; (ii) *poor communication* between the three spheres of government and between government and industry; (iii) *lack of resources* (human, financial and technological) within government to develop, implement and sustain the WIS; (iv)

lack of experienced or knowledgeable staff within government, as it relates to the WIS; (v) current *lack of data* to populate the WIS and uncertainty as to the accuracy and reliability of existing data.

3.3 Identifying the opportunities

Opportunities are recognised as those aspects which are currently aligned with the desired state or objective of the WIS and which would provide a foundation for the development and implementation of the WIS, i.e. areas where little or no gap exists between design and reality. Such opportunities include (i) institutional restructuring in DEAT in response to an expressed need for a WIS, thereby creating a staffed sub-directorate at national government responsible for overseeing the WIS; (ii) sufficient time, with a project duration of 3 years to allow for systematic design, development, testing, redesign and final implementation; (iii) financial resources at national government to support the design, development, testing and initial implementation, and (iv) impending legislative reform, to support legal enforcement.

4. Reducing the design-reality gap

The design-reality model (Heeks, 2002) proposes that by reducing the design-reality gap, the risk of system failure will be reduced. The design-reality gap may be reduced by either changing the system design (*design improvisation*) or changing actuality (*actuality improvisation*) (Heeks, 2002). This paper focuses on how one can reduce the design-reality gap for the WIS, through design improvisation, by addressing four key identified constraints or ‘gaps’:

- Information constraints
- Technology constraints
- Capacity constraints
- Financial constraints

Although each issue is discussed separately, the following sections will show the inter-relatedness of these four constraints and the influence that each one has on the other during system design improvisation.

4.1 Information constraints

Government and industry in South Africa are currently collecting very little data on waste and where data is collected, the accuracy and completeness of this data is questionable. The implications of the national policy on pollution and waste (DEAT, 2000), would be the need to collect detailed data, from a large number of role players (estimated at 200 000 companies), on a wide array of pollution and waste issues. To be able to collect all of this data would require complex and sophisticated information systems, many highly skilled staff in government and industry and significant financial resources in order to be sustainable.

With financial and human resources identified as a key constraint, the feasibility of being able to collect all of the envisaged data, let alone verify, process and disseminate the data, is unlikely. A phased or iterative approach to the development of the national WIS would however allow for the system to grow together with the capacity of government and industry,

fundamental to the systems sustainable implementation in South Africa.

A phased approach, both in terms of the detail of the required data as well as the providers of data was adopted. Detail of data is expanded upon with time, from e.g. indicating the type of waste simply as hazardous in phase 1, to identifying the specific pollutants (hazardous category) in phase 4. Data providers are expanded upon by focussing on end-of-pipe facilities (landfills, treatment, reprocessors) in phase 1 and phasing in generators in phase 4. Thresholds are also used to phase in data providers, e.g. by requesting data from only medium and large general waste landfill sites in phase 1, data on 84% of the waste stream can be obtained from only 27% of the landfill sites (DWAF Baseline Data, 1998). Phase 1 requires a more limited volume of data for the system, which, in turn, reduces the human resource and associated financial burden on government and industry, but still provides sufficient data to government for effective planning. The framework provides sufficient detail on the first four phases of implementation to allow flexibility for local authorities and provinces to choose to implement the WIS more comprehensively, where resources are available to them.

4.2 Technology constraints

To support government in the collection, verification and dissemination of data, the WIS must be: accessible to all stakeholders; reliable in terms of completeness and accuracy; and reasonably fast. Use of a web-based WIS made the most sense, since it would allow for data providers to directly submit data on-line to government. It would also provide all three spheres of government with access to data stored within the WIS, thereby promoting the sharing and dissemination of data. Statistics however show that only 9.9% of the South Africa population (~ 4.8 million users) have access to the Internet. In relation to the rest of Africa, South Africa has shown slower growth in Internet usage over the past five years (99.2% over the period 2000-2005) (Table 1), but is at the level of Internet growth experienced globally (169.5%) (Table 2).

The statistics provided some degree of assurance that South Africa would continue to experience Internet user growth and connectivity, with more municipalities and companies being connected to the Internet. As such a web-based approach was adopted, however the system design would also need to provide for the capturing of data by those companies with no access to the Internet. A web-based approach however opened up a number of security and user access issues. The system needed to be developed to ensure that data could not be altered or deleted once verified and that data providers and users had restrictions on access to certain data.

Table 1. Internet Usage Statistics for South Africa and Africa (Internet World Stats, 2005)

AFRICA	Population (2005 Est.)	Internet Users Dec/2000	Internet Users, Nov/2005	% Population (Penetration)	(%) Users in Africa	User Growth 2000-2005
South Africa	48,051,581	2,400,000	4,780,000	9.9 %	20.0 %	99.2 %
TOTAL AFRICA	896,721,874	4,514,400	23,917,500	2.7 %	100.0 %	429.8 %

Table 2. Comparison of South Africa and World Internet Statistics (Internet World Stats, 2005)

World Regions	Population (2005 Est.)	Population % of World	Internet Usage, Nov/2005	% Population (Penetration)	Usage % of World	Usage Growth 2000-2005
South Africa	48,051,581	0.75 %	4,780,000	9.9 %	0.49 %	99.2 %
WORLD TOTAL	6,420,102,722	100.0 %	972,828,001	15.2 %	100.0 %	169.5 %

4.3 Capacity constraints

The original thinking around the national WIS (DEAT, 1999) was one of all data providers providing data to local government, who would collate and submit to provincial government who would verify and submit to national government. This approach placed a considerable work load onto local government as the principle recipient of data. While this approach made sense in terms of the constitutional mandates of local and provincial government, the question of the number of staff required versus the available capacity within local government was identified as an issue of concern.

A review of capacity assessments of local municipalities in 2003/04 (Municipal Demarcation Board, 2005), indicated that 54.2% of municipalities could not fully perform their existing waste management functions as assigned to them under the Constitution. Reasons given for non-performance included insufficient budget; insufficient staff; insufficient equipment; service not required; poor access to areas; and ‘other’ (Table 3), with 40.8% of all municipalities indicating non-performance due to a lack of staff.

Table 3. Percentage of local authorities which indicated non-performance of waste service delivery for 2003/04 (Municipal Demarcation Board, 2005).

Insufficient budget	Insufficient staff	Insufficient equipment	Service not required	Poor access to areas	Other
45.4%	40.8%	38.7%	13.4%	11.3%	6.7%

How could national government assign additional responsibilities through the implementation of the WIS, to a sphere of government which was already underperforming with respect to waste management and which lacked budget and staff?

Meeting the original demands of the WIS (DEAT, 1999), meant either (i) increasing the number of government positions required to manage the WIS (an additional 370-850 positions), or (ii) designing the WIS to be less reliant on a large number of government officials, particularly at local government where the bulk of the load was seen to fall. Since the problem with capacity is not so much about creating positions, but rather in filling positions and retaining staff, it was not considered sustainable to develop a WIS which relied on a large number of skilled staff. As such, design improvisation needed to consider how to (i) change the roles and responsibilities of the spheres of government in alignment with human resource constraints, or (ii) reduce the dependency of the WIS on scarce resources through improved technology. This was achieved by changing the roles and responsibilities of local government

in the system design, by moving the bulk of the administrative activity away from the 284 local authorities to the nine provinces, thereby concentrating staff and activities at provincial government level. This in conjunction with a reduction in the data load (Section 4.1) would result in fewer staff requirements particularly for phase 1 of system implementation.

4.4 Financial constraints

Development and implementation of a WIS requiring an operational budget of R57 million per annum (DEAT, 1999), raises concerns as to the socio-economic feasibility of such a system in a developing country such as South Africa.

South Africa, a lower-middle income country, has an unemployment rate of 26.5% (Statistics South Africa, 2005), with 23.8% of South Africans living on less than \$2 a day (at 1993 international prices). (World Bank, 2004). This level of poverty is further compounded by the fact that between 1994 and 2002 the number of South African families living in shacks doubled to reach 1.8 million (World Bank, 2004). 42.9% of households in South Africa do not have access to refuse removal and 32.2% of households do not have access to piped water (HSRC, 2006). South Africa faces many basic challenges of housing, water, sanitation, health services, security and job creation. As indicated in Section 4.3, 45.4% of all local authorities indicated that they did not have sufficient budget to be able to fully perform their existing waste management functions.

While it is recognised that a national WIS is important in supporting the improved management of waste in South Africa and thereby reducing the impacts of waste on the environment and human health, it is the opinion of the author that the development of an information system which requires an operating budget of R57 million (\$9.7 million) per annum can not be justified in light of South Africa's socio-economic status and the challenges facing society. R57 million could perhaps be better served in firstly meeting the basic societal needs of the country, e.g. R57 million could build approximately 2 300 low-cost houses a year⁽¹⁴⁾, or in supporting the improved engineering of landfill sites in South Africa, actions which would have immediate, short-term rewards.

The goal in system design was therefore to find a balance between the need for a system and the cost of development, implementation and operation. In particular to develop a system that required a lower annual operating cost. Since the bulk (R53.5 million or 94%) of the proposed annual operating cost was made up of salaries of government officials (DEAT, 1999), reducing the annual operating cost could only be achieved by reducing the number of people required to successfully operate the WIS. It was recognised that reducing the number of people involved would ultimately affect the quantity and/or quality of data which could be collected. Since the quality of data could not be compromised, the implication of reducing the number of people involved in the operation of the WIS, would be to (i) reduce the quantity of data required by government and (ii) make the system as efficient as possible so that data can be timeously entered, verified and disseminated (See section 4.1 and 4.3).

The WIS, following the above data, technology and capacity design improvisations (Sections 4.1-4.4), is expected to have an annual operating cost to government of ~ R5 million (\$850 000) per annum, less than 10% of the original operating budget. A budget considered more justifiable in a young democracy such as South Africa. A higher operating budget will be

⁽¹⁴⁾ A 23m² Reconstruction and Development Programme (RDP) house is estimated to cost approximately R25 000 to build (Department of Housing, 2005).

required as further phases are implemented, a process which will hopefully parallel economic growth in South Africa and the improvement of basic services to all South Africans.

5. Conclusions

Design improvisation has been a necessary step in the development of a national waste information system for South Africa to ensure, as far as possible, system sustainability. It has also provided a challenge in finding the balance in improvisation between the four key design components, data, technology, capacity and finances. The inter-relatedness of these four components has required a clear objective of the intent of the WIS.

Design improvisation has seen a need to reassess the roles and responsibilities of the various government departments responsible for the WIS, so as to reduce the dependency of the system on large staffing requirements and thereby costly annual operating budgets. It has also required the phased implementation of the system, and the introduction of data thresholds, so as to reduce the data requirements and thereby the associated capacity and financial resources. This phased implementation allows the system to grow together with the capacity of government and industry.

The success in designing a sustainable WIS will only however be realised in the coming 2-3 years, as the system is rolled out to all provinces.

6. Acknowledgements

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THE ROLE OF THE SOUTH AFRICAN WASTE INFORMATION SYSTEM IN IMPROVING WASTE MANAGEMENT

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SUMMARY: Piloting of the South African Waste Information System (SAWIS) provided an opportunity to research, whether the collection of data for a national waste information system could, through a process of learning, change the way that waste is managed. Interviews with officials from municipalities and private waste companies highlighted that certain organizations, typically private waste companies have been successful in collecting waste data. Through a process of learning, these organizations have utilized this waste data to inform and manage their operations. The drivers of such data collection were seen to be financial (business) sustainability and environmental reporting obligations, particularly where the company had an international parent company. Participants also highlighted a number of constraints, particularly within public (municipal) waste facilities which hindered both the collection of waste data and the utilization of this data to effect change. These constraints included a lack of equipment and institutional capacity in the collection of data. The utilization of this data in effecting change was further hindered by governance challenges such as politics, bureaucracy and procurement challenges.

1. INTRODUCTION

Pockets of compliance with waste legislation exist in South Africa. However waste, and in particular domestic waste, is largely not being duly managed, resulting in a negative impact on the environment (Bosman & Boyd, 2008; DEAT, 2006a; DEAT, 2006b; Godfrey & Scott, in press). The need therefore exists for public and private waste organizations to improve the effectiveness of current waste management practices. The South African Department of Environmental Affairs and Tourism (DEAT) (now the Department of Environment (DEA)) identified the need to develop waste information systems (WIS) to:

“provide accessible information to interested and affected parties that will support effective integrated pollution and waste management” and in so doing, *“ensure informed decision making, measure progress in policy implementation and enable public participation in the governance of integrated pollution and waste management”* (Republic of South Africa, 2000:42).

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The DEAT developed the South African WIS (SAWIS) between 2004 and 2006. The approach to the SAWIS is that municipalities and private waste companies collect waste data at the waste facilities, e.g. tonnage of general municipal waste delivered to the landfill. This waste data is converted to information through a process of collation and analysis, e.g. total monthly tonnage of general waste landfilled; by the relevant waste officer, and then submitted to the SAWIS.

This paper explores whether the collection of waste data for the SAWIS, and the conversion of this data to knowledge, can support the original intentions of the WIS. In particular the paper aims to explore the research question “*Can the collection of data for a national waste information system, change the way waste is managed in South Africa, such that there is a noticeable improvement?*” The paper focuses on three sub-questions guided by the theoretical framework: Do organizations have the ability to collect data on solid waste? Do employees have the ability to assimilate and interpret the data and through a learning process build new knowledge? Do employees (and organizations) have the ability to convert this knowledge into impact (potential to implement change in managing waste)? Unlike studies which have focused on the role of information technology, i.e. the waste information system, in influencing behaviour (de Man, 2006; Chiasson and Saunders, 2005), this research focuses on the waste data and information, and through a process of learning, changing personal behaviour. This paper presents a summary of a more comprehensive research paper (Godfrey & Scott) in press.

2. THEORETICAL FRAMEWORK

2.1 Knowledge as a precursor to action

A dichotomy exists between theorists who propose that making data and information available to individuals has the potential to influence actions by building knowledge – ‘information-action’ theorists (Denisov et al., 2005; Stephan et al., 2005), and those who argue that a tenuous relationship, if any, exists between knowing what to do and acting on that knowledge (Weiss, 2002; Pfeffer & Sutton, 2000).

Environmental information disclosure, science communication and environmental education, which draw from behavioural psychology, are three disciplines which have provided significant theoretical contributions to understanding the impact of environmental information on decision-making processes. Information disclosure is a recognised environmental policy instrument capable of eliciting desired outcomes (Stephan et al., 2009; Denisov et al., 2005; Kolominskas & Sullivan, 2004). Research has shown that information can make people aware of the consequences of their behaviour and influence their opinions, attitudes and knowledge (Denisov et al., 2005; Weiss, 2002; Howes, 2001). In so doing, policy makers then rely on people to use this newly acquired information and resultant knowledge to change their behaviour so as to meet the required policy intention. The underlying assumptions in information strategies are that people respond to information; respond to information out of their own accord; that people have ‘limitless capacity’ to absorb new information; and that people have endless motivation to alter their behaviour based on what is considered ‘optimal behaviour’; and that knowledge generated through the internalization of information is linked to action (Weiss, 2002).

2.2 The process of learning

The process of learning (Miller & Morris, 1999) (**Figure 1**) provides a preliminary theoretical framework for assessing the potential impact of data on resultant action. Learning is considered to be a process of "gaining knowledge, comprehension or mastery", "acquiring or creating knowledge" (Allee, 1997:50) or as a relatively permanent change in behaviour, or behaviour potential (Baron, 1995). Learning is seen as the conversion of data to information through assimilation and interpretation, which when combined with existing theory (which puts that information into the correct context) and experience of real world applications, builds a person's knowledge (Poch et al., 2004; Miller & Morris, 1999; Allee, 1997).

Miller and Morris (1999) note that decision-making today is often based on data and information "to the near-total neglect" of knowledge, with information often being mistaken for knowledge. According to Allee (1997:62) "information becomes knowledge when it is analyzed, linked to other information, and compared to what is already known". Knowledge is therefore seen as being an important component of attitude formation and of behaviour. According to Allee (2003:264), knowledge is considered as the "capacity to act".

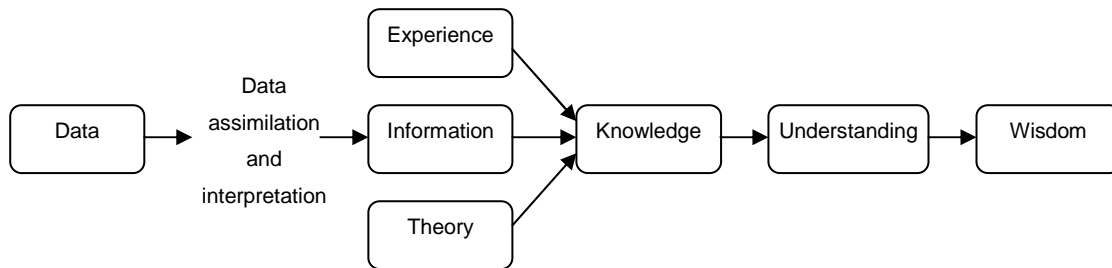


Figure 1: Process of learning (adapted from Miller & Morris, 1999)

3. MATERIALS AND METHOD

According to previous research (Denisov and Christoffersen, 2001; Jones, 2001), the impact of information on resultant actions often cannot be directly observed or measured. This may be due to time lags between providing information and resultant action, and in singling out the impact of one piece of information from a multitude of behavioural influences. For this reason, this paper adopts an exploratory, interpretive approach so as to rather seek understanding through the application of the preliminary theoretical framework.

3.1 Sampling

The municipalities and private waste companies participating in the SAWIS pilot study were identified by means of a set of predetermined selection criteria (Godfrey & Scott, in press). Based on the evaluation criteria, two provincial departments of environment, Mpumalanga and the Eastern Cape, and three municipalities, Mbombela, Buffalo City and Nelson Mandela Metro were selected for piloting of the SAWIS (5 public organisations). Seven private waste companies and three municipalities, operating a total of 16 facilities (10 waste landfills, 2

treatment facilities and 4 reprocessing facilities) were identified to participate in the study.

3.2 Data collection

Interviews with waste officers from participating organizations were the main source of primary data collected for this research. The interviews were conducted by the first author as part of the pilot project review task (DEAT, 2006c). A total of 19 interviews were held with representatives of the 12 organizations (DEAT, 2006c). The organizational status of respondents ranged from senior line managers responsible for waste, to technical managers, to waste officers and clerks.

For the purposes of this research, and given the qualitative and exploratory nature of the study, data were collected by means of semi-structured interviews (Whitley, 2002). This instrument for data collection has the advantage of following an interview guide with specific themes related to the aim of the study; however, there was no specified order in which the topics or questions were covered. The interview schedule with its specified themes allowed for the comparability of data between interviews (Whitley, 2002). At the same time, the open-ended questions in the interview schedule provided a more conversational approach (Whitley, 2002). Respondents were in this way provided with an opportunity to raise issues related to the research question which may not have been recognized prior to the interviews.

3.3 Analysis and interpretation

This research adopts an interpretative approach to data analysis, which includes description, classification and connection; categorizing and interpreting the data in terms of common themes, and synthesis of data into an overall portrait of the cases (Leedy and Ormond, 2005; Kitchin & Tate, 2000). Data analysis involved sorting and categorizing a large body of interview transcript data, into a small set of pertinent themes, making use of category trees (**Figure 2**) (Leedy and Ormond, 2005; Kitchin & Tate, 2000). In the thematic analysis, two techniques were chosen for interpretation of the research data; pattern matching and explanation building (Yin, 2003). While the research was framed within a preliminary theoretical framework of learning, the interpretive approach allowed for the emergence of themes and sub-themes not originally identified in the interview schedule.

4. RESULTS AND DISCUSSION

The interpretation of the interview data focused on the aim of the paper, which was to gauge the likely impact of collecting data for the SAWIS on improving the way waste is managed in South Africa. As such, the results are discussed within the three broad themes: the ability of organizations to collect waste data; the ability of employees to assimilate and interpret the data and generate new knowledge; and the ability of employees and organizations to convert this knowledge to impact.

4.1 Ability of organizations to collect data

With regards to the ability of organizations to collect data, the interviews revealed three sub-themes: differences between facility type (public or private); the drivers of successful data collection; and constraints to successful data collection (**Figure 2**).

The findings highlighted that eight of the 12 organizations were already collecting some waste data prior to the start of the SAWIS pilot project. What was evident from the interviews was that a difference existed between private and public facilities, particularly with regards to data collection prior to the implementation of the SAWIS. Only one of the five public institutions that participated in the pilot project had a prior data collection system in place, whereas all private facilities had some prior system for waste data collection. Private waste companies appeared to be generally more successful at collecting data than the public facilities.

It was found that the main drivers for organizations having already implemented data collection systems prior to the piloting of the SAWIS were organizational. These drivers included financial sustainability, e.g. revenue recovery (billing) and reducing operational costs; or environmental reporting obligations e.g. ISO14000, particularly where the company had an international parent company (**Table 1**). Financial reasons for data collection were particularly evident amongst recycling companies who are paying to buy in waste. Respondents from all of the recycling companies interviewed highlighted the importance of keeping sound records of the quantities of waste purchased. Environmental reporting obligations, e.g. ISO 14000 or reporting to international holding companies was also found to be a driver of data collection amongst the majority of private organizations (**Table 1**).

Table 1: Correlation between private/public waste facilities and data collection practices

Province	Facility ownership	Prior data collection	Data collection driven by
Eastern Cape	public	No	-
	public	No (Partly)	-
	public	Yes	Financial - client billing
	private	Yes	Financial - client billing; reduce operational costs
	private	Yes	Financial – pay for waste (recycled); ISO 14000
	private	Yes	Financial – pay for waste (recycled)
	private	Yes	Financial – pay for waste (recycled)
Mpumalanga	public	No	-
	public	No	-
	private	Yes	ISO 14000; Legislation (human tissue)
	private	Yes	ISO 14000 (International parent) Financial – reduce operational costs
	private	Yes	ISO 14000 (International parent) Financial – reduce operational costs

Constraints to data collection (**Figure 2**) were found to hinge specifically around lack of equipment, particularly information technology (IT), and capacity. Equipment constraints included the lack of computers, email and internet, and the lack of weighbridges at landfills.

The lack of IT equipment appeared largely to be a problem within municipalities. The lack of equipment at waste facilities, e.g. weighbridges, was seen to impact upon the reliability and accuracy of data collected for the SAWIS. From the interview data, institutional capacity was found to be a predominant constraint within municipalities. This lack of skilled capacity at waste facilities impacts upon issues as simple as being able to identify the type of waste being generated or received, or estimating the tonnages of waste carried by vehicles entering municipal landfill sites.

4.2 Ability of employees to assimilate and interpret the data and build new knowledge

The second theme apparent in the data is the ability of employees to assimilate and interpret the collected waste data into information, and then build new knowledge through a process of learning. The interviews revealed three sub-themes: evidence of data interpretation; data not used; and poor understanding of data use (**Figure 2**).

With regards to the first sub-theme, the interviews showed that in instances, respondents have assimilated and interpreted the collected waste data (generating information), and in so doing, recognized possible uses of the information to improve the way in which waste is managed. Evidence of particular applications of the information, include improved management of the vehicle fleet; planning for current and future waste facilities; costing of operations; and ongoing site operation and maintenance. In one instance, a municipal landfill site had

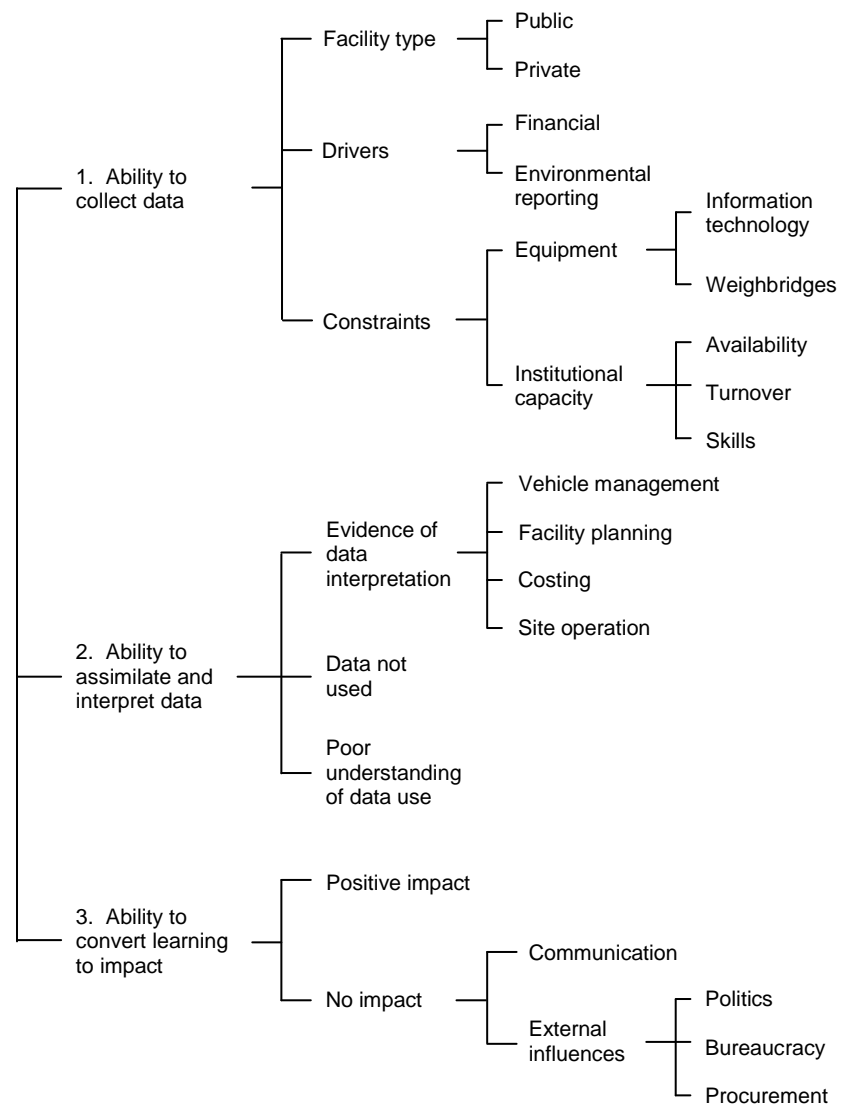


Figure 2: Summary: The ability to change the way waste is managed through data collection

records on vehicles entering the landfill for the first time. This data on vehicles entering the landfill also provided the municipality the opportunity to identify that their transfer station was not working effectively, resulting in all vehicles driving out to the landfill at an increased operational cost.

While all participating private landfill sites, and those public landfills in the larger metropolitan municipalities were charging for the disposal of waste at the time of this research, one of the local municipalities which participated in the pilot did not charge. Because of data collection for the SAWIS, this municipality was now looking into disposal tariffs for the new planned landfill site. The application of data for improved site operation was identified by respondents from both public and private waste facilities. Operational issues for landfill sites focused on managing remaining airspace in landfill sites, as well as planning the airspace needs for future landfills.

The interviews highlighted that some organizations do not use the data after having collected it, and have no concept of the usefulness of having the data available, or alternatively have a poor understanding of the potential use of this data.

4.3 Ability of employees and organization to convert this knowledge to impact

The third theme revealed in the interview data is the ability of employees and organizations to convert this resultant knowledge to impact, and in so doing bring about change in the way waste is currently managed. The interviews highlighted few areas of direct positive impact leading from the SAWIS data collection, as well as areas of no or little noticeable impact in operations (**Figure 2**).

Positive impacts noted by respondents included the placement of new staff at landfill sites to improve the flow of vehicles onto the site, thereby freeing up existing staff to collect the required data. In one particular case, the security guard at the entrance of the landfill had previously been tasked with both directing vehicles to the tipping face as well as collecting waste data. However, since the research showed that all participating private waste companies had already been collecting data prior to the SAWIS, it is difficult to distinguish the impact of the SAWIS data collection from that already implemented through existing management practices.

According to the provincial waste officer, the collection of data by the municipality has not had any positive impact on landfill management. Even at the public hospitals, data collection has had no impact on waste management. In instances, collected data was not being used at all after submission to the SAWIS, with no potential to generate knowledge or cause change.

This raises the question as to why in certain circumstances individuals with acquired knowledge act on that knowledge to implement changed waste practices, while in other instances, this acquired knowledge does not lead to impact? According to Pfeffer and Sutton (2000), while information and knowledge are 'crucial to performance', knowledge of an issue is often not sufficient to cause action: "*there is only a loose and imperfect relationship between knowing what to do and the ability to act on that knowledge.*" (Pfeffer & Sutton, 2000:25). This frequent

inability to transfer knowledge of what needs to be done into action or behaviour which is consistent with that knowledge, is referred to by Pfeffer & Sutton (2000) as the 'knowing-doing gap'. According to Pfeffer & Sutton (2000) the gap between knowing and doing is more significant than the gap between ignorance and knowing. This is due to the fact that considerable knowledge already exists, which is either already known to an individual, or can be readily sourced, yet lack of implementation persists.

In the case of the SAWIS, this lack of impact from waste data collection to changed waste practices may result from a communication 'gap' between those who collect and interpret the data, and those who have the responsibility and ability for decision-making and effecting change. While data collection may result in new information generation, if the information is not communicated to the decision-makers within the organization, the potential for resultant impact may be lost.

The interviews also highlight a number of external factors which make it difficult for staff within municipalities and private waste companies to use the acquired knowledge to improve the management of waste, e.g. South Africa's political situation and low priority afforded to waste management, organizational bureaucracy particularly within municipalities, and ineffective and inefficient organizational procurement policies. The external influences and apparent frustrations of politics, bureaucracy and procurement, which hinder implementation, were only noted by respondents from municipalities and not from private waste companies.

While little direct evidence was provided by respondents for resultant changes directly due to data collection, the reasons and influences for no or limited change were perhaps more insightful into understanding the research question, and in particular the constraining factors external to the individual.

5. CONCLUSIONS

The research question was explored in this paper through a preliminary theoretical framework of learning (Miller and Morris, 1999) and addressed three sub-questions: Do organizations have the ability to collect data on solid waste? Do employees have the ability to assimilate and interpret the data and through a learning process build new knowledge? Do employees (and organizations) have the ability to convert this knowledge into impact (potential to implement change in managing waste)? Applying a qualitative, interpretative approach provided an opportunity to identify further sub-themes which emerged from the interview data (**Figure 2**).

In terms of Theme 1, the ability to collect waste data, the interviews highlight differences in an organization's ability to collect data, with private waste companies having successfully implemented waste data collection systems. It is evident that there are external factors, or drivers, which have resulted in these organizations already implementing data collection systems well before the piloting of the SAWIS. The main drivers were found to be financial sustainability e.g. revenue recovery (billing) and reduced operational costs; and environmental reporting obligations e.g. ISO14000, particularly where the company had an international parent company. However, participants also highlighted the current constraints to data collection,

typically within public waste facilities, specifically focusing on the lack of equipment, particularly IT (computers, internet and email connectivity) and lack of capacity (availability, turnover, skills) to collect and interpret the data.

The data showed that in terms of Theme 2, the ability to assimilate and interpret data and through a learning process build new knowledge, certain persons interviewed have assimilated and interpreted the waste data collected for SAWIS, utilizing this knowledge to inform and manage the organizations operations, including vehicle management; facility planning, costing of operations, and ongoing site operation and maintenance. Similarly, there are organizations that do not use the data after having collected it, and therefore do not see the usefulness in having the data available to them, or have a poor understanding of the potential use of this data.

It was also found that in terms of Theme 3, the ability to convert this knowledge to impact, little evidence was found for resultant change in waste practices as a result of data collection during the piloting of the SAWIS. While the desire may exist within individuals to implement change based on this new knowledge, the point of knowledge generation may be removed from the point of decision-making within organizations due to a break in communication, or may be constrained by organizational bureaucracy and administrative procedures. These external factors have made it difficult for persons, particularly within municipalities to both collect waste data, or from the raised awareness associated with the interpretation and internalization of data, to implement the necessary changes within their organization. These external factors hinged largely around governance.

While the preliminary theoretical framework of learning provides a means for interpreting the interview findings, the results showed that knowledge is a necessary but insufficient condition for resultant action. The conceptual framework of learning was shown to be too simplistic for understanding the role of waste data in a developing country context such as South Africa, and did not account for external influences. It is proposed that further research is necessary to establish a more conceptually inclusive framework, which explains the complex nature of learning, behaviour and potential for action and impact from environmental information, and specifically waste information, within the South African context.

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WHY BUILDING CAPACITY IS A NECESSARY BUT INSUFFICIENT CONDITION FOR IMPROVED WASTE MANAGEMENT IN SOUTH AFRICA: THE KNOWLEDGE – BEHAVIOUR RELATIONSHIP

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ABSTRACT

One of the main reasons given for the current state of waste management in South Africa includes human resource capacity constraints, in particular the difficulty in recruiting suitably qualified or skilled people, and the high turnover of staff within government. Local government, in particular, faces serious challenges with regards to available skills and capacity. The need for education and capacity development in the field of waste management has been recognised in a number of recent studies as a way of addressing these challenges. This paper explores whether building capacity in the field of waste management in South Africa is sufficient to improve the way that waste is currently managed in the country. The Theory of Planned Behaviour (Ajzen, 1985) one of the most frequently applied and empirically proven action theories in environmental behaviour research, provides a basis to evaluate this research question. The theory proposes that a combination of behavioural, normative and control beliefs form behavioural intentions which result in behaviour. Findings show that building capacity, which support control beliefs, while certainly a necessary condition, is insufficient to change waste behaviour. Consideration needs to be given by the waste sector to how behavioural and normative beliefs can be strengthened, by addressing issues of consequence and outcome and the importance given to pollution and waste issues, as a means of converting behavioural intentions to action.

1. INTRODUCTION

The environment outlook for South Africa for 2006 showed that levels of municipal waste service delivery improved by only 2.7% between 1996 and 2001, with almost 50% of the South African population not receiving a regular waste collection service (DEAT, 2006b). In addition 59.7% of the 231 local municipalities indicated that they could not perform their waste management functions (Godfrey & Dambuza, 2006). While it is acknowledged that there are many well operated sanitary landfill sites in South Africa in line with international best practice, of the 1203 known public and private landfill sites in the country, only 43.6% are authorised through permits (DEAT, 2006a). Of those permitted, compliance with permit conditions is seldom audited and often unknown. While pockets of compliance exist, waste is currently not being duly managed in South Africa. This results in a negative impact on the environment which requires the improvement in the effectiveness of current waste management practices

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(Bosman & Boyd, 2008; DEAT, 2006; DEAT, 2006b).

The Department of Environment Affairs (DEA) (formerly Department of Environmental Affairs and Tourism) suggests capacity constraints as one of the main reasons for the decline in the management of waste (DEAT, 1999; DEAT, 2006b; DEAT, 2006c). Difficulty in recruiting suitably qualified or skilled people into government positions has been further compounded by the high turnover of staff within all three spheres of government (Godfrey, 2007). Local government, in particular, faces serious challenges with regards to available skills and capacity, both in terms of the number of staff as well as expertise (DEAT, 1999a; DEAT, 2006b; COGTA, 2009). The DEA (DEAT, 2007) recognise that the primary intervention in support of municipalities running a sustainable waste management service is the strengthening of municipal human resource capacity. This is supported by research findings which suggest that capacity building is one of five mechanisms to address the current challenges facing municipalities with regards to waste service delivery (Oelofse and Godfrey, 2008). This is in line with Keating (1993) who noted:

“A country's ability to develop more sustainably depends on the capacity of its people and institutions to understand complex environment and development issues so that they can make the right development choices” (Keating, 1993).

National waste policy, such as the White Paper on Integrated Pollution and Waste Management (IP&WM) (Republic of South Africa, 2000) and the National Waste Management Strategy (NWMS) (DEAT, 1999a) identify the need for further capacity building in South Africa. This suggested capacity building would support government, industry and civil society in better managing waste and reducing the impact of pollution from waste on the environment. According to Department of Environmental Affairs (DEAT, 1999b:8), the *“level of knowledge, skills and competencies relating to waste management varies significantly between the different implementing agencies at national, provincial and local government level”*. It is recognised that government will only be effective in the implementation of the NWMS and its corresponding Action Plans if it has both qualified and competent personnel in national, provincial and local government (DEAT, 1999a). The DEA recognises the importance of building, as well as retaining, technical waste management capacity within government. It is acknowledged that government has promulgated extensive environmental legislation and regulations since the promulgation of the Environment Conservation Act (Republic of South Africa, 1989) (Godfrey & Nahman, 2008), to address threats to environmental and human health. However, a *“lack of capacity to implement”*, is identified in the NWMS (DEAT, 1999a:7) as one of the limitations.

There are many definitions in the literature for capacity and capacity building. These definitions vary from simply increasing knowledge or skills (human resource capacity) through education, training or awareness programmes, to more extensive definitions that include not only this aspect of human resource development, but also organisational and institutional development. The World Customs Organization (WCO) defines capacity building as *“activities which strengthen the knowledge, abilities, skills and behaviour of individuals and improve institutional structures and processes such that the organization can efficiently meet its mission and goals in a sustainable way”* (WCO, 2003). According to The Urban Capacity Building

Network (GDRC, 2007), capacity building is more than just training and includes:

- *Human resource development*, the process of equipping individuals with the understanding, skills and access to information, knowledge and training that enables them to perform effectively.
- *Organizational development*, the elaboration of management structures, processes and procedures, not only within organizations but also the management of relationships between the different organizations and sectors (public, private and community).
- *Institutional and legal framework development*, making legal and regulatory changes to enable organizations, institutions and agencies at all levels and in all sectors enhance their capacities.

Many definitions for capacity and capacity building are also evident in South African literature. The Municipal Structures Act (Republic of South Africa, 1998:14) defines capacity as the “*administrative and financial management capacity and infrastructure that enables a municipality to collect revenue and to govern on its own initiative the local government affairs of its community.*” The DEA in their action plan for capacity building, education, awareness and communication (DEAT, 1999b:51) define capacity building as “*the developmental processes, which enable an organisation and its people to confidently and competently, undertake their organisational responsibilities.*” To undertake such organisational responsibilities requires having the appropriate knowledge to manage waste. This implies both a skill of knowing what needs to be done, as well as an enabling environment to support the behaviour.

For the purposes of this research, the authors focus specifically on the development of human resource capacity, i.e. the appropriate qualifications and skills, developed through education, training and experiential learning, as a means to strengthening organisational capacity. The paper does not address aspects of capacity such as equipment and infrastructure.

This paper aims to address the role that human resource capacity, considered here to be specific knowledge, has on the management of waste in South Africa. This research question is explored in relation to the theoretical framework, which outlines the linkages between knowledge and behaviour and uses this theoretical framework to assess whether capacity development in a developing country context such as South Africa, can result in the improved management of waste.

2. MATERIALS AND METHOD

The findings presented in this paper are based on the observations made by the first author over the past 15 years of being involved in the South African waste sector. These observations are supported by primary data collected from numerous research projects undertaken by the first author. Such supporting research projects include the piloting of the South African Waste Information System (SAWIS) (Godfrey, 2008; Godfrey & Scott, in press); the assessment of economic instruments in South Africa (Godfrey & Nahman, 2008) and a systems approach to waste management (Godfrey & Oelofse, 2008). Further supporting data was obtained from

technical reports prepared for government departments responsible for the management of waste in South Africa.

3. THE GENERATION OF KNOWLEDGE

Knowledge of how to effectively manage waste in a changing environment comes about through the learning process (Miller & Morris, 1999). Such a learning process involves the “*integration of information derived from data, plus theory that puts the information in the proper context, plus experience of how things work in the real world*” (Miller & Morris, 1999:77) (**Figure 1**). In the context of waste management, knowledge is dependant upon three aspects, accurate and reliable waste data and information; waste training and education programmes (the “theory”) and opportunity for experiential learning.

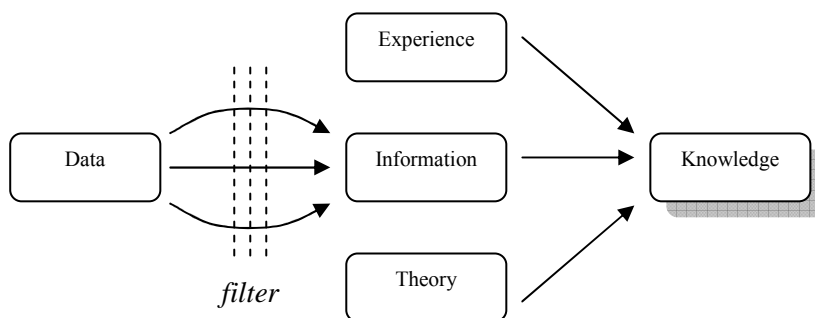


Figure 1. Process of learning (from Miller & Morris, 1999)

According to Allee (1997:62) "*information becomes knowledge when it is analysed, linked to other information, and compared to what is already known*". Knowledge is considered as the 'capacity to act' (Allee, 2003:264) and as such, is seen as being an important component of attitude formation and of behaviour change.

4. THE THEORY OF PLANNED BEHAVIOUR

Perhaps the most frequently applied and empirically proven action theory in environmental behaviour research, and certainly in understanding waste recycling behaviour, is the theory of planned behaviour (Ajzen, 1991; Ajzen, 1985), referred to by Kollmuss and Agyeman (2002:243) as having been “*the most influential attitude-behaviour model in social psychology*”. The theory of planned behaviour has been used to understand behavioural change in numerous fields, including health studies, in particular behavioural change with respect to HIV/AIDs (Fishbein *et al.*, 2001) and in waste recycling studies (Barr, 2007; Mosler *et al.*, 2008).

The theory of planned behaviour (**Figure 2**), suggests that action (behaviour), represented by means of behavioural intention, is a function of three factors, attitude toward the behaviour or **behavioural beliefs**; subjective norms or **normative beliefs**; and perceived behavioural control or **control beliefs**. A person's *attitude* towards a specific behaviour is seen as a function of the

perceived positive or negative outcomes or consequences of performing the behaviour and the desirability of these consequences. A good correlation was found between attitude and behaviour where there was a high awareness of consequence (Fransson & Gärling, 1999). The subjective norms relate to the social environment or social pressures, i.e. the person's perception that an individual or group important to them, e.g. family, colleagues, employers or government; expects them to perform (or not perform) the given act. This is influenced by the person's motivation or desire to comply with the perceived expectations of that reference group or the reference groups perceived power or authority over the person (Oom Do Valle, 2005; Weiss, 2002; Ajzen & Fishbein, 1973). According to Ajzen (1985:12), "generally speaking, people intend to perform a behaviour when they evaluate it positively and when they believe that important others think they should perform it".

The theory of planned behaviour maps out the causal links from personal and social beliefs, through attitudes and intentions, to overt behaviour, i.e. behaviour over which a person has full control or the power of determining outcome. Pfeffer & Sutton (2000:157) refer to this as an 'atomistic view' which assumes that "individual outcomes and individual behaviour are under the control and discretion of those individuals, so that results and decisions can be reasonably attributed to individuals". Research has shown, however, that while actions are controlled by behavioural intentions, intentions may not always manifest as action, even if the personal intention or willingness is there (Chung & Leung, 2007; Ajzen, 1985; Ajzen & Fishbein, 1973). A number of factors impact upon the manifestation of intention as behaviour; including degree of *volitional control* (Ajzen, 1985). Perceived behavioural control has been described as the ease with which the behaviour can be performed; a person's perception of the difficulty of performing a behaviour, or the presence and extent of factors which either facilitate or hinder performance, i.e. a person's beliefs about available resources, opportunities and specific knowledge (Oom Do Valle et al., 2005; Ajzen, 1991). What van Birgelen *et al.* (2009:130) refer to as the "extent to which a person thinks his or her own actions will have an impact on the situation as a whole". A person is more likely to act if they are confident in their ability to perform it or if strong *barriers* are removed (Ajzen, 1991; Gardner & Stern, 1996).

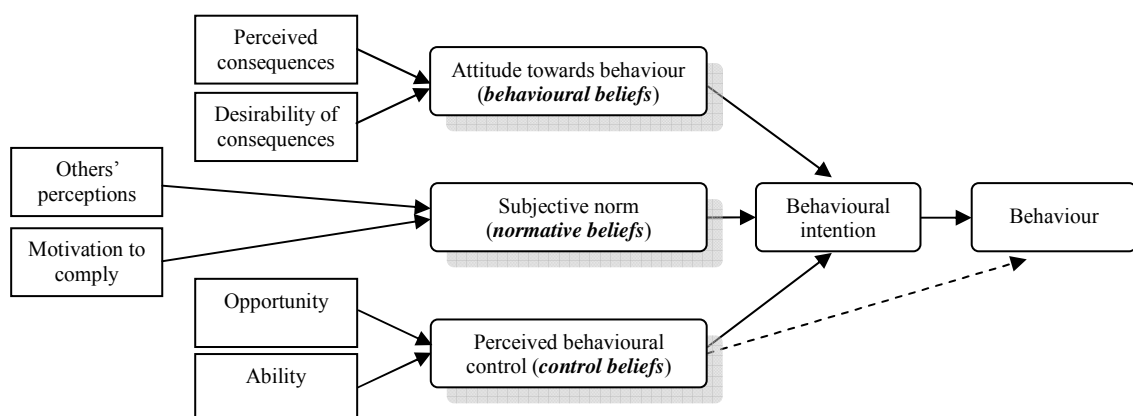


Figure 2. Theory of Planned Behaviour (from Ajzen & Fishbein, 1973; Ajzen, 1985; Ajzen, 1991)

5. DISCUSSION

The theory of planned behaviour provides a structured framework against which to gauge the influence of human resource capacity, and in particular knowledge, on resultant waste behaviour. The following section focuses on the three main constructs of the theory of planned behaviour as they relate to waste management in South Africa, namely control beliefs, behavioural beliefs and normative beliefs. Each is discussed below in further detail, with the aim to assess key trigger points in improving the way that waste is currently managed in the country.

5.1 Control beliefs

Perceived behavioural control has been described as the ease with which the behaviour can be performed; a person's **ability** to perform and the **barriers** or obstacles that may stand in the way of such performance.

The theoretical framework put forward in **Figure 3**, is a combination of two theories, the theory of planned behaviour (Ajzen, 1991) and the process of learning (Miller & Morris, 1999). The theoretical framework suggests that building new knowledge (or human capital development) through a process of learning, has the potential to impact upon behavioural, normative and control beliefs, and in so doing, influence behavioural intention and ultimately action (Gardner & Stern, 1996; Ajzen, 1985). Knowledge may raise a person's awareness regarding the outcomes or consequences of a behaviour (or non-behaviour), thereby altering the person's attitude towards the behaviour. Knowledge may alter a referent's awareness regarding the outcome of a behaviour, thereby placing more or less pressure on the person conducting the behaviour (change of subjective norms). Finally, increasing a person's knowledge (through a process of learning), can make them more capable of completing the behaviour, thereby giving them more control over their behavioural intention. The theory therefore suggests that knowledge has the ability to influence behavioural intentions and resultant action.

However, according to Pfeffer and Sutton (2000), while knowledge is 'crucial to performance', knowledge of an issue is often not sufficient to cause action: "*there is only a loose and imperfect relationship between knowing what to do and the ability to act on that knowledge*" (Pfeffer & Sutton, 2000:25). This frequent inability to transfer knowledge of what needs to be done into action or behaviour which is consistent with that knowledge, is referred to by Pfeffer & Sutton (2000) as the 'knowing-doing gap' or the 'performance paradox' (Cohen, 1998 in Pfeffer & Sutton, 2000). While it was believed that the 'knowing-doing gap' was due to a lack of personal knowledge or skills, research conducted by Pfeffer & Sutton (2000) suggests that while personal knowledge is important in ensuring action, it is not as important as having management systems and practices in place. According to Pfeffer & Sutton (2000) the gap between knowing and doing is more significant than the gap between ignorance and knowing. This is due to the fact that considerable knowledge already exists, which is either already known to an individual, or can be readily sourced, yet lack of implementation persists.

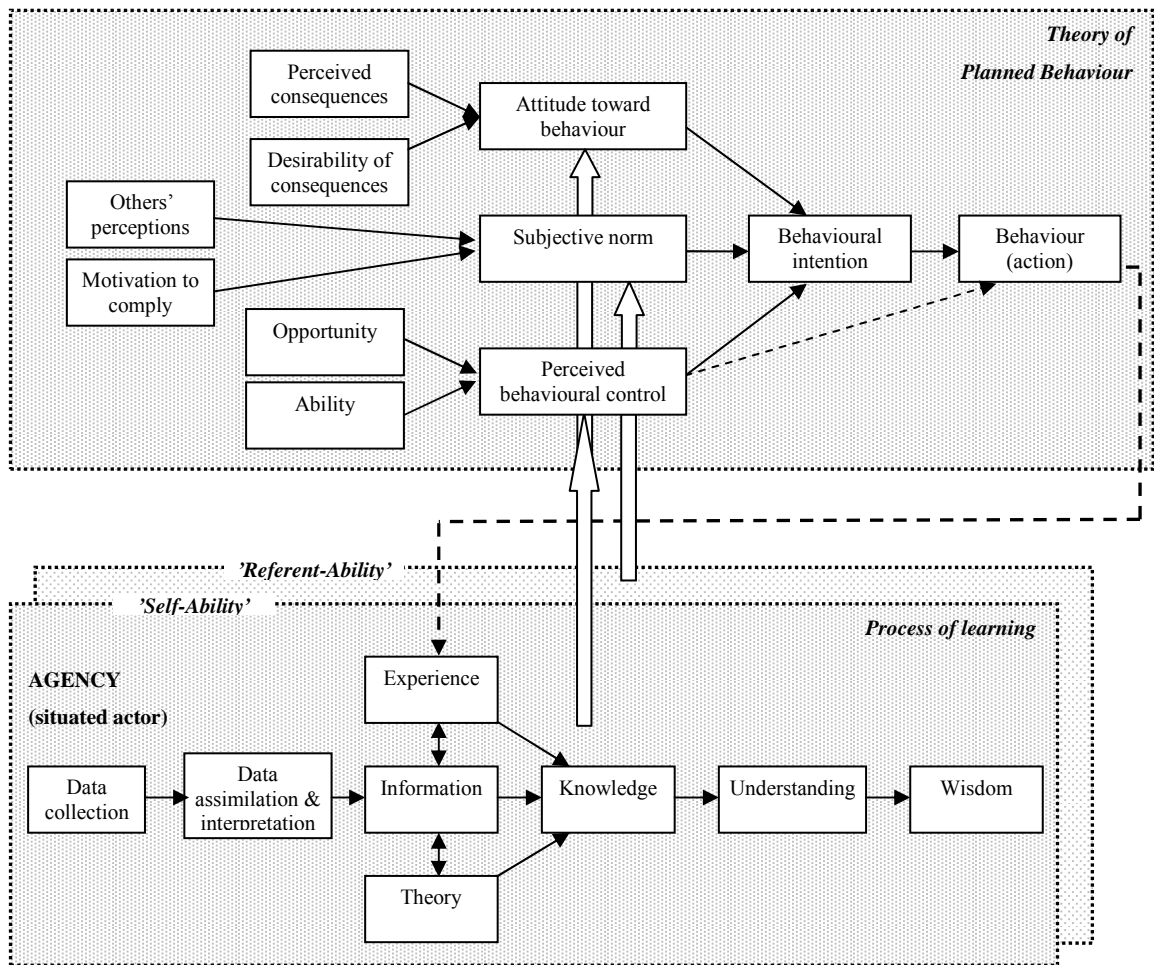


Figure 3. Learning and behaviour (adapted from Miller & Morris, 1999 and Ajzen, 1991)

“ While a municipality which has sufficient capacity [knowledge] should be viable, this is not always the case. A number of internal and external factors can easily affect municipal viability. Certainly, municipal capacity cannot and should not be equated to municipal viability” (MDB, 2008:107).

Research conducted as part of the implementation of the South African Waste Information System (Godfrey & Scott, in press) showed that certain persons interviewed have assimilated and interpreted the waste data collected for SAWIS, utilising this knowledge to inform and manage the organisations operations, i.e. through a learning process build new knowledge. However, when it came to converting this knowledge to impact, little evidence was found for resultant change in waste practices as a result of this new knowledge. The desire may exist within individuals to implement change based on this new knowledge and raised awareness around waste management practices. However, it was found that the point of knowledge generation may be removed from the point of decision-making within organisations. This could be due to a break in communication, or it may be constrained by organisational bureaucracy and administrative procedures. These external factors have made it difficult for persons, particularly within municipalities to implement the necessary changes within their organisation. It was

found that these external factors hinge largely around governance (Godfrey & Scott, in press). “...the *Municipal Structures Act* defines capacity in relation to a municipality as ‘the administrative and financial management capacity and infrastructure that enables a municipality to collect revenue and to govern on its own initiative the local government affairs of its community’. The definition does not reflect the external economic and social conditions in which the municipality is found but rather the municipal institutional requirements for delivering services.” (MDB, 2008:108)

Behavioural and normative beliefs must therefore also play an important role in formulating behavioural intentions and resultant action.

5.2 Behavioural beliefs

A person's *attitude* towards a specific behaviour or behavioural beliefs is seen as a function of the perceived positive or negative outcomes or **consequences** of performing the behaviour and the **desirability** of these consequences. With regards to behavioural beliefs, the authors have specifically identified current perceptions regarding consequences of legislative non-compliance, and the desirability of these consequences.

South Africa has one of the most advanced constitutions in the world in terms of the protection of human rights, including the right to a safe and healthy environment. In addition, it has some of the most progressive environmental legislation in the world (UNDP, 2003). However, government has typically been perceived to be unwilling and/or unable to enforce pollution and waste-related legislation (Lukey et al., 2004; Seeliger et al., 2003; Republic of South Africa, 2000; London & Rother, 2000). A public perception exists that government is unwilling and/or unable to “*come down hard on polluters*” (Lukey et al., 2004). A review of landfill data collected by the national Department of Water Affairs and Forestry (DWAF) and the Department of Environmental Affairs and Tourism (DEAT) in 2005, shows that only 43.6% of the 1203 landfill sites in South Africa are known to be permitted (DEAT, 2006a), and of those permitted, little to no information exists on their compliance with permit conditions. Of the non-permitted/unknown permit status landfill sites, in excess of 90% are thought to be municipal landfills. It would therefore appear that the biggest culprit of non-compliance in the landfilling of waste is local government (Godfrey, 2008). Unpermitted municipal landfill sites are a problem in terms of implementation of environmental legislation in South Africa (SabinetLaw, 2009).

This lack of enforcement against municipalities is largely due to South African legislation which recognises the importance of co-operative governance across the three spheres of government in waste management matters. However, co-operative governance effectively means that legal action cannot be taken by one sphere of government, e.g. the national DEA, against another sphere of government, e.g. a municipality, without first having exhausted “*all other remedies before it approaches a court*” (Republic of South Africa, 1996:14). According to Bosman and Boyd (2008:856), “*cooperative governance principles are preventing the implementation of legal proceedings*” with the result that command-and-control policy instruments are not ensuring environmental compliance in South Africa. This lack of

consequence, particularly with regards to non-compliant municipal waste operations and facilities, is currently a governance challenge facing South Africa with the potential to create inconsistencies in enforcement (Bosman and Boyd, 2008; Engledow and Groeners, 2008) and dual enforcement standards for public and private waste facilities. The result is often a difference in approach to waste management practices between public and private entities. A perception has therefore developed, certainly amongst municipalities, that there is little to no consequence of legislative non-compliance.

“A lack of government capacity means that the enforcement of existing legislation is frequently unfocused, especially with regard to waste disposal” (Republic of South Africa, 2000:23).

Ineffective enforcement of waste legislation has also resulted in the improper management of landfills that are not designed and operated according to Minimum Requirements (DWAF, 1998). The result is that landfilling is still too cheap in South Africa, creating price distortions in the waste system, which makes landfilling the preferred means of waste disposal. Such price distortions have resulted in a largely, unsustainable recycling sector, which remains a relatively more expensive alternative. This is in conflict with national policy which supports the waste hierarchy of waste avoidance, reuse, recycling, treatment and landfilling (Godfrey & Nahman, 2008). The result is a perceived lack of consequence for non-compliance with waste legislation in many areas of the waste sector. This behaviour has entrenched and institutionalised many practices which now hinder integrated waste management, and in instances conflict with national policy, e.g. the White Paper on Integrated Pollution and Waste Management and the issue of salvaging from landfills.

The recent promulgation of the Waste Act (Republic of South Africa, 2008) however, provides for hefty fines and imprisonment for contravention of the Act. For example, in terms of Section 68 (1) of the Waste Act, a person convicted of an offence referred to in section 67(1) (a), (g) or (h) of the Act, is liable to a fine not exceeding R10,000,000 (approximately US\$ 1,250,000) or to imprisonment for a period not exceeding 10 years. These penalties are considerably more onerous on the waste sector than the previous Environmental Conservation Act and if successfully enforced by government, will provide a platform for addressing consequence for legal non-compliance.

5.3 Normative beliefs

Subjective norms relate to the social environment or **social pressures**, i.e. the person's perception that an individual or group important to them, e.g. family, colleagues, employer or government; **expects them to perform** (or not perform) the given act. This is influenced by the person's motivation or **desire to comply** with the perceived expectations of that reference group or the reference groups perceived power or authority over the person. With regards to normative beliefs, the authors have identified the current perceptions regarding the importance placed on waste management by both the South African government and society, and the resultant sense of pressure to comply with good waste management practices.

The Department of Environmental Affairs highlighted, as one of the key issues relating to pollution and waste in the White Paper on Integrated Pollution and Waste Management, the:

“Lack of priority afforded to waste management: In the past, waste management was not afforded the priority it warrants as an essential function required to prevent pollution and protect the environment and public health. Consequently, insufficient funds and human resources were allocated to this function. In many instances this neglect has resulted in a lack of long-term planning, information, appropriate legislation and capacity to manage the waste stream.” (Republic of South Africa, 2000:23)

This low priority afforded to waste in South Africa was noted by government in both the White Paper on Integrated Pollution and Waste Management (Republic of South Africa, 2000) and the National Waste Management Strategy (DEAT, 1999a, 1999b). There is little evidence however, to suggest that this situation has changed over the past decade (DEAT, 2009; Godfrey & Oelofse, 2008; Godfrey & Scott, in press). Research undertaken in selected municipalities in South Africa showed that the current lack of political will (Godfrey & Oelofse, 2008; Ball, 2006) given to waste management still results in a low priority being afforded to waste, particularly within municipalities. Ultimately, this low priority for waste, when combined with other factors, results in e.g. insufficient funding being assigned to waste services which impacts further on issues such as equipment management, labour (staff) management and institutional behaviour (management and planning) (Godfrey & Oelofse, 2008). The Community Agency for Social Enquiry note in their 2003 report on municipal cost recovery: *“waste is viewed as being a low expenditure priority”* (CASE, 2003:42). This is confirmed by the Department of Environmental Affairs (DEAT, 2007:67) in their assessment of the status of waste service delivery and capacity at the local government level: *“Waste is not recognised as a priority service and typically gets allocated the left over budget after electricity, water, roads etc. Waste management is not recognised as a priority service by Municipal Councils who are responsible for budget allocations.”* This lack of priority is resulting in failing waste management services which impacts negatively on both environmental and human health (Oelofse and Godfrey, 2008).

“The level of governmental capacity in the field of waste management is generally extremely limited. This lack of capacity within government, and (to a lesser extent) within the private sector, has resulted in waste management generally being regarded as a low priority issue.” (DEAT, 1999b:6).

Waste management was also found to be of generally low priority by society. Research undertaken by Phiri (2007) showed that waste management ranked eighth out of 11 quality of life aspects, with factors such as education, employment, health, accommodation, public safety, energy and transport seen to be of higher priority. This priority is confirmed by Ball (2006) who noted that basic needs such as water, food, shelter, roads, material possessions, electricity, and sewage typically precede the human need for waste management. *“Waste management seldom has a priority of higher than fifth place. Consequently, waste management is also usually relegated to a relatively low priority with regard the attention it receives”* (Ball, 2006:3).

This low priority afforded to waste creates little incentive for waste companies or municipalities, to perform or comply with the requirements and expectations of important

stakeholders, such as national government.

6. CONCLUSIONS

A lack of capacity, and in particular human resource capacity, is recognised as a current challenge to waste management in South Africa. Building South Africa's knowledge base through training and education programmes has been identified as a mechanism to improve the way in which waste is managed, by changing the behaviour of those persons responsible for managing waste within municipalities and private waste companies. This paper reviews whether building capacity can lead to an improvement in the way that waste is managed in South Africa. The Theories of Planned Behaviour and Process of Learning provide a theoretical framework against which to evaluate this research question. According to theory, building new knowledge (human resource capacity) through a process of learning has the potential to impact upon behavioural, normative and control beliefs, and in so doing, influence behavioural intention and ultimately action. The main aim of capacity building is to increase a person's knowledge (ability) so as to make them more capable of completing the behaviour (control beliefs), thereby giving them more control over their behavioural intention.

There is no doubting that building the capacity of those individuals responsible for the management of waste in South Africa, through training and education programmes, is imperative to improved levels of service delivery. However, research conducted in South Africa shows that building knowledge is not always sufficient for resultant action. While a person may want to apply their newly acquired knowledge through improved waste management practices, their behaviour is subject to societal and organisational factors, which may make it difficult for them to translate behavioural intention into action. Behaviour is not always completely under a person's volitional control. Building capacity is only one of three necessary components of behavioural intention. As such it is a necessary but insufficient condition for changing the way in which waste is managed in South Africa.

Evidence suggests that much can still be done by government, the waste sector and society to address the other two components of the Theory of Planned Behaviour – behavioural beliefs and normative beliefs. The current perception of there being a lack of consequence for legislative non-compliance (behavioural beliefs) and the low priority afforded to waste, particularly within municipalities, (normative beliefs) is believed to impact significantly on the way in which waste is managed in South Africa. Weakened behavioural and normative beliefs in this way undermine the behavioural intentions of those persons tasked with managing waste, ultimately impacting upon the desired behaviour (**Figure 4**). While the recently promulgated Waste Act provides a legislative platform from which to do this, focusing on improved capacity alone will not have the desired outcome of improved waste behaviour in South Africa.

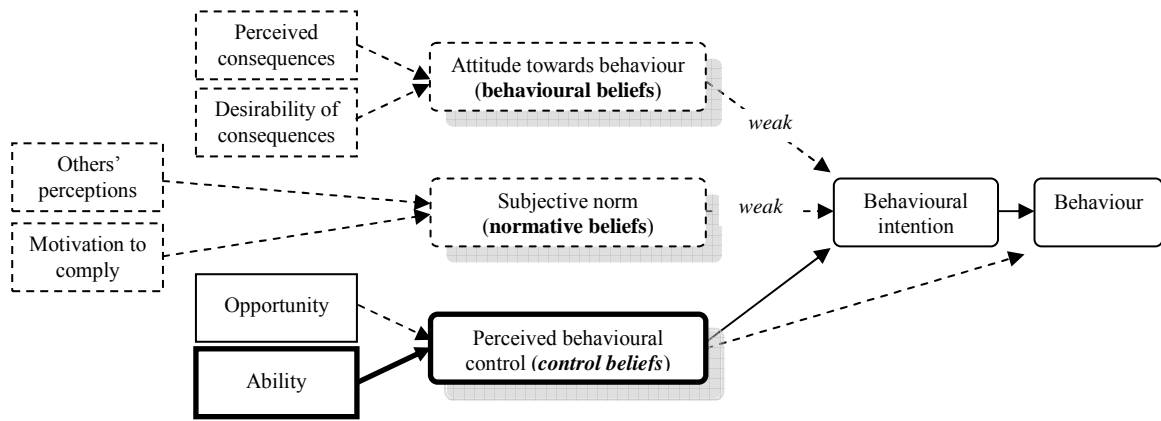


Figure 4. The impact of weakened behavioural and normative beliefs on desired behaviour

Strengthening behavioural and normative beliefs which provide a sense of consequence, importance and social pressure to comply, can be achieved by government taking a strong position on the importance of waste management and non-compliance. This could be achieved through strong policy statements and increased waste awareness, which would be further supported by ongoing development of human resource capacity.

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