

# 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).*

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 – the ‘information-action’ theory (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).

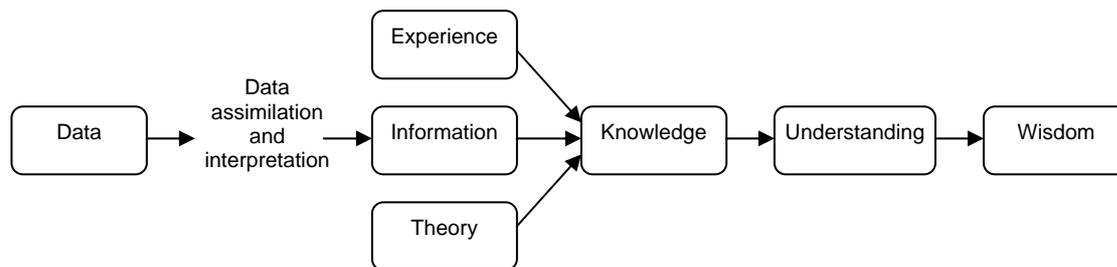
Environmental information disclosure, science communication and environmental education, which draw from behavioural psychology, are three disciplines which have provided significant theoretical contributions to understanding the impact of environmental information on decision-making processes. Information 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 existing 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); drivers to 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 hinged around 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 seen as a predominant constraint within municipalities. This lack of skilled capacity at waste facilities was seen to impact 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.

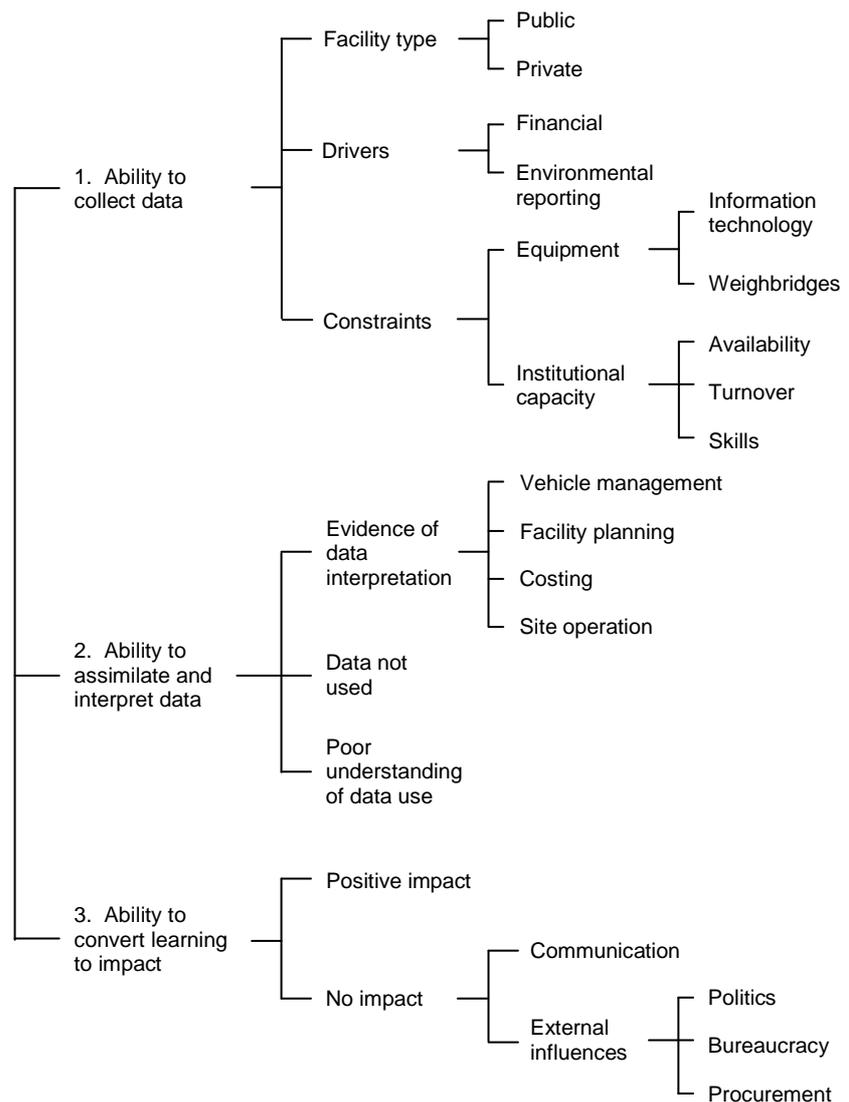
#### 4.2 Ability of employees to assimilate and interpret the data and build new knowledge

The second theme 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. 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 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. 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 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.



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

### 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, 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, 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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