

IMPROVING WASTE MANAGEMENT IN A DEVELOPING COUNTRY THROUGH A PROCESS OF LEARNING: THE SOUTH AFRICAN WASTE INFORMATION SYSTEM

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Abstract:	<p>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 organisations, typically private waste companies have been successful in collecting waste data. Through a process of learning, these organisations have utilised 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 utilisation 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 utilisation 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.</p>

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IMPROVING WASTE MANAGEMENT IN A DEVELOPING COUNTRY THROUGH A PROCESS OF LEARNING: THE SOUTH AFRICAN WASTE INFORMATION SYSTEM

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 organisations, typically private waste companies have been successful in collecting waste data. Through a process of learning, these organisations have utilised 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 utilisation 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 utilisation 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

1. 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, 2006). 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 1280 known public and private landfill sites (general and hazardous) in the country, only 44% are authorised 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

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3 managed in South Africa, resulting in a negative impact on the environment and this requires
4 intervention. The need exists for public and private waste organisations to improve the effectiveness
5 of current waste management practices.
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10 The South African Department of Environmental Affairs and Tourism (DEAT), in its White Paper on
11 Integrated Pollution and Waste Management (IP&WM), identified the need to develop waste
12 information systems (WIS) to “provide accessible information to interested and affected parties that
13 will support effective integrated pollution and waste management” and in so doing, “ensure informed
14 decision making, measure progress in policy implementation and enable public participation in the
15 governance of integrated pollution and waste management” (Republic of South Africa, 2000:42). The
16 DEAT developed the South African WIS (SAWIS) between 2004 and 2006. It has been shown that
17 the impact of environmental information is increased through understanding the end users and their
18 needs for information (Denisov & Christoffersen, 2001). As such, the SAWIS was based on specific
19 needs identified by key stakeholders from both public and private waste institutions (Godfrey, 2008).
20 The identified needs for waste data include strategic requirements at national and provincial
21 government level with more operational needs at local government and at the waste facility level
22 (Godfrey, 2008). For waste information to support policy objectives (Republic of South Africa, 2000)
23 and the needs of stakeholders (Godfrey, 2008), the routine collection of data must move beyond
24 simple collection to also include data assimilation and interpretation, and conversion to knowledge.
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36 This paper explores whether, through the conversion of data to knowledge, these original intentions
37 for a WIS can be fulfilled in a developing country such as South Africa. In particular the paper aims
38 to explore the research question “*Can the collection of data for a national waste information system,
39 change the way waste is managed in South Africa, such that there is a noticeable improvement?*”
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44 Unlike studies which have focussed on the role of information technology, i.e. the waste information
45 system, in influencing individual and organisational behaviour (de Man, 2006; Chiasson and Saunders,
46 2005), this research focuses on the waste data and information, and through this process of learning,
47 changing personal behaviour.
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52 **2. Knowledge as a precursor to action**

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55 A dichotomy exists between theorists who propose that making data and information available to
56 individuals has the potential to influence actions by building knowledge and capacity – the
57 ‘information-action’ theory (Denisov *et al.*, 2005; Stephan *et al.*, 2005; Denisov & Christoffersen,
58 2001; Bruch 2000), and those who argue that a tenuous relationship, if any, exists between knowing
59 what to do and acting on that knowledge (Weiss, 2002; Pfeffer & Sutton, 2000; Miller & Morris,
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3 1999; Finger, 1994). Environmental information disclosure, science communication and
4 environmental education, which draw from behavioural psychology, are three disciplines which have
5 provided significant theoretical contributions to understanding the impact of environmental
6 information on decision-making processes (Stephan *et al.*, 2009; Denisov *et al.*, 2005; Weiss, 2002).
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11 Information disclosure is a recognised environmental policy instrument capable of 'eliciting' or
12 'inducing' desired outcomes (Stephan *et al.*, 2009; Denisov *et al.*, 2005; Kolominskas & Sullivan,
13 2004; Antweiler & Harrison, 2003). Research has shown that information can make people aware of
14 the consequences of their behaviour and influence their awareness, opinions, attitudes and knowledge
15 (Denisov *et al.*, 2005; Weiss, 2002; Howes, 2001). In so doing, policy makers then rely on people to
16 use this newly acquired knowledge to change their behaviour so as to meet the required policy
17 intention.
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24 While information disclosure has been used internationally in many domains ranging from public
25 health, energy conservation, environmental management to family planning (Denisov *et al.*, 2005;
26 Weiss, 2002), perhaps the most well known example of successful information strategies, is the Toxic
27 Release Inventory (TRI) implemented in the United States in 1986 in response to the chemical
28 accident at a Union Carbide plant in Bhopal, India (Stephan *et al.*, 2005; Nauman, 2004). Based on
29 the principles of community-right-to-know, the TRI requires that certain listed industries report on the
30 quantity and types of pollutants released to air, water and soil, and transferred off-site for disposal,
31 which are then made available to government and the public. The empirical evidence suggests that
32 TRI information disclosure has had positive impacts in reducing the volumes of pollutants discharged
33 to the environment, through raised industry awareness of wasteful processes (Kolominskas & Sullivan,
34 2004; Howes, 2001) and social pressure (Stephan *et al.*, 2009; Antweiler & Harrison, 2003; Weiss,
35 2002).
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44 The proposition put forward by those researchers in favour of 'information-action', is that information
45 can make people aware of the consequences of their behaviour and influence their awareness and
46 knowledge regarding this behaviour (Weiss, 2002; Howes, 2001). The underlying assumptions in
47 information strategies are that people respond to information; respond to information out of their own
48 accord; that people have 'limitless capacity' to absorb new information; and that people have endless
49 motivation to alter their behaviour based on what is considered 'optimal behaviour'; and that
50 knowledge is linked to action (Weiss, 2002).
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57 Unlike information-disclosure strategies such as the TRI, the SAWIS does not make facility specific
58 information available to the public. As such, the issue of public pressure as a driver of change
59 (Stephan *et al.*, 2009) is not considered within this research question. Instead this research focuses on
60 resultant change from only those actors involved in collecting and reporting the data. In addition,

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3 those actors expected to implement change, are not necessarily directly at risk from the waste, as in the
4 case of vulnerable communities (Barr, 2007; Tietenberg & Wheeler, 1998). Unlike America, where
5 implementation of the TRI has been largely successful (Stephan *et al.*, 2005), this paper focuses on
6 solid waste management specifically in the South African context as a developing country, and not
7 broader pollution management. At the time of this research, reporting to the SAWIS was not
8 regulated, but voluntary in nature, although regulations to enforce reporting to the SAWIS were under
9 consideration (Republic of South Africa, 2009).
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16 3. Preliminary theoretical framework

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19 Organisational learning provides an additional perspective on the role of knowledge informing action
20 (Lai *et al.*, 2009). Organisational learning is shown to be a means of influencing actions through
21 improved knowledge and understanding thereby affecting organisational outcomes and effectiveness
22 (Lai *et al.*, 2009; Robey *et al.*, 2000). In terms of a resource-based view of organisations, knowledge
23 is considered the “most significant strategic resource for organizations” (Lai *et al.*, 2009:543). Since
24 organisational learning can be measured at the individual, group or organisational level (Robey *et al.*,
25 2000), knowledge is considered critical in improving personal knowledge of employees and raising
26 their levels of awareness, thereby influencing organisational learning and in so doing driving
27 organisational action and effectiveness.
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36 Miller and Morris (1999) note that decision-making today is often based on data and information “to
37 the near-total neglect” of knowledge, with information often being mistaken for knowledge (Moeletsi
38 & Novella, 2004). According to Allee (1997:62) "information becomes knowledge when it is
39 analysed, linked to other information, and compared to what is already known". Knowledge is
40 therefore seen as being an important component of attitude formation and of behaviour. According to
41 Allee (2003:264), knowledge is considered as the 'capacity to act'.
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48 The process of learning provides a preliminary theoretical framework for interpreting the case study
49 data, as discussed in the Sections 3 and 4 (**Figure 1**) (Miller & Morris, 1999). The process of learning
50 allows for collected data to be assimilated, interpreted (converted to information) and together with the
51 application of existing theory (which puts that information into the correct context) and experience of
52 real world applications, builds up a knowledge base (Poch *et al.*, 2004; Miller & Morris, 1999; Allee,
53 1997). Learning is considered to be a process of "gaining knowledge, comprehension or mastery",
54 "acquiring or creating knowledge" (Allee, 1997:50) or as a relatively permanent change in behaviour,
55 or behaviour potential (Baron, 1995).
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3 The paper focuses on three sub-questions guided by the theoretical framework: Do organisations have
4 the ability to collect data? Do persons have the ability to assimilate and interpret the data, building
5 knowledge? Do persons (and organisations) have the ability to convert this learning into impact
6 (potential to implement change in managing waste)?
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10 11 **4. Materials and methods** 12

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14 According to existing research (Denisov and Christoffersen, 2001; Jones, 2001), the impact of
15 information on resultant actions often cannot be directly observed or measured. This may be due to
16 time lags between providing information and resultant action, and in singling out the impact of one
17 piece of information from a multitude of behavioural influences. For this reason, this paper adopts an
18 exploratory, interpretive approach so as to rather seek understanding through the application of the
19 pre-conceptual framework, specifically as it relates to waste management (Leedy & Ormrod, 2005).
20 Due to the exploratory nature of this research, a detailed explanation of the research methodology, as
21 outlined in the following sections, is deemed necessary.
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29 **4.1 Positionality** 30

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32 A postpositivist, interpretive research approach in the social sciences, recognises that the investigator
33 and investigated are not independent entities (Mottier, 2005; Henning *et al.*, 2004), and any knowledge
34 gathered through the research is 'marked by its origins' and needs to be situated or positioned relative
35 to both the researcher and that which is being researched (Rose, 1997). In so doing, it makes the
36 position of the researcher known, thereby limiting the potential for overgeneralizing or universalizing
37 from the research findings (Rose, 1997). This section presents the role of the first author in the
38 SAWIS pilot study.
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45 In support of the development of the SAWIS, the system was piloted in two provinces in South Africa,
46 Mpumalanga and Eastern Cape between 2005-2006. A review of the pilot project was conducted by
47 the author¹ at the end of the piloting period, to assess five elements fundamental to the long-term
48 success of SAWIS, namely anchoring and ownership; capacity development; resource requirements;
49 communication and outreach; and system sustainability. The findings of this review are summarised
50 in a report by the primary author to the Department of Environmental Affairs and Tourism (DEAT,
51 2006c). The SAWIS pilot project review therefore provided a unique opportunity to undertake a
52 preliminary exploration of the *potential for impact* of data collected for the SAWIS on the way waste
53 is managed in South Africa.
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¹ Ms Linda Godfrey was appointed by the Department of Environmental Affairs and Tourism between 2004 and 2006 as Local Support Consultant: Waste Information System, to oversee the development and piloting of the SAWIS.

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5 It is recognised that access to specific individuals within organisations is often difficult to obtain,
6 especially within government departments where access may be denied due to senior management or
7 political concerns around highlighting internal governance weaknesses. Direct access to persons
8 responsible for the management of waste and/or those responsible for the implementation of the
9 SAWIS within their organisations was facilitated by the author being part of the national government
10 project team, tasked with piloting the SAWIS, which made data collection easier. The primary
11 author's involvement in the South African waste sector over the past 15 years, which resulted in her
12 being known to most individuals who participated in the SAWIS pilot study, further facilitated
13 engagement with respondents and supported the research approach.
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21 4.2 Sampling

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24 The municipalities and private waste companies participating in the SAWIS pilot study were identified
25 by means of a set of predetermined selection criteria, which were developed to ensure that a fair and
26 transparent process was followed in evaluating the suitability of the nine provinces in South Africa.
27 The aim was to identify two suitable provinces and associated participating municipalities and private
28 waste companies. The selection criteria included both institutional and technical criteria, as outlined
29 in **Table 1**.
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35 The criteria for selecting the participating institutions were based on their suitability in terms of the
36 SAWIS testing which therefore provided a purposeful sampling frame in terms of the research
37 requirements. Based on the evaluation criteria, two provinces, Mpumalanga and the Eastern Cape, and
38 three municipalities, Mbombela, Buffalo City and Nelson Mandela Metro were selected for piloting of
39 the SAWIS. Seven private waste companies and three municipalities, operating a total of 16 facilities
40 (waste landfills, treatment facilities or reprocessing facilities), volunteered to participate in the study
41 (**Table 2**). A total of 12 organisations were selected for further research, as part of this project. The
42 SAWIS pilot project therefore allowed for a multiple case study design (Yin, 2003).
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50 4.3 Data collection

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53 Case study based research provides a variety of means for data collection and evidence gathering, e.g.
54 direct observation, participant-observation, interviews, and the review of documents and artefacts
55 (Yin, 2003). For the purpose of this research, primary qualitative data was collected. Such primary
56 data included personal observations of SAWIS pilot project participants made during the course of the
57 one year pilot project (September 2005 to November 2006); data collected through one-on-one
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3 interviews with waste officers in both public and private institutions; and the review of consultant
4 reports prepared during the SAWIS pilot project, technical reports and government publications.
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8 Interviews with waste officers from participating organisations were the main source of primary data.
9 The interviews were conducted by the author as part of the pilot project review task (DEAT, 2006c).
10 Since the SAWIS was implemented in only selected pilot organisations that fulfilled certain initial
11 requirements, limited persons were available to interview. Of the 18 persons contacted two did not
12 agree to be interviewed and two had not participated sufficiently in the pilot projects. A total of 19
13 interviews were held with representatives of 12 organisations, 7 industries, 2 provincial departments
14 and 3 municipal departments (DEAT, 2006c). The number of participating organisations and resultant
15 interviews provided a relatively small sample of respondents from appropriate organisations who were
16 able to share insights into the successful piloting of the SAWIS. The organisational status of
17 respondents ranged from senior line managers responsible for waste within provincial and municipal
18 departments, to technical managers in municipalities, hospitals and private waste companies, to waste
19 officers and clerks appointed by the municipalities or waste companies to oversee the collection and
20 submission of data to the SAWIS.
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31 Interviews provide an appropriate means of obtaining information on personal beliefs, opinions,
32 experiences, attitudes, behaviours and conscious reasons for actions (Leedy and Ormond, 2005;
33 Kitchin & Tate, 2000; Kerlinger, 1986). For the purposes of this research, and given the qualitative
34 approach (Coolican, 2004; Yin, 2003), data were collected by means of semi-structured interviews
35 (Whitley, 2002). This instrument for data collection has the advantage of following an interview
36 guide with specific themes related to the aim of the study. However, there was typically no specified
37 order in which the topics or questions were covered (Whitley, 2002) given the exploratory nature of
38 the study. This flexible approach gives the appearance of a guided conversation as opposed to a
39 structured interview (Yin, 2003). The interview schedule with its specified themes did however allow
40 for the comparability of data between interviews (Whitley, 2002). At the same time, the open-ended
41 questions in the interview schedule provided a more relaxed atmosphere and a more conversational
42 approach (Whitley, 2002). Respondents were in this way provided with an opportunity to raise issues
43 related to the research question which may not have been recognised prior to the interviews.
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52 While interviews provided a direct means of gathering information from people, they are not without
53 their shortcomings. The most critical shortcoming in interviews is that of social desirability in which a
54 respondent provides the interviewer with what he or she feels is most socially acceptable or desirable
55 rather than what they may truly feel or believe (Allen & Santrock, 1993). This was of particular
56 concern given that the project was seen as a national government initiative and interviews were
57 conducted with representatives of 'subordinate' provincial and municipal departments. This is also
58 often experienced with interviews which are recorded (Leedy and Ormond, 2005). While notes were
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3 taken during all interviews, the interviews were recorded. This freed the author up to follow the
4 discussions and pose new questions prompted by the direction of the conversation (Coolican, 2004),
5 while at the same time ensuring that no subtle information was missed. Every effort was made to
6 make the interviewee feel relaxed so as to overcome any nervousness associated with the recorder. In
7 addition, all interviewees were guaranteed confidentiality to reduce voluntary censoring of responses.
8 To ensure that all participants had an opportunity to provide input into the research, without bias from
9 colleagues or supervisors, single person interviews were conducted. While it is preferable that
10 interviews are conducted in a suitable location, preferably one where the respondent is unlikely to be
11 distracted or interrupted (Leedy and Ormond, 2005), this was not always possible. All persons
12 interviewed are responsible for ongoing waste management activities which require their attention
13 during office hours. All interviews were therefore conducted in the work place of the respondent.
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23 4.3 Analysis and interpretation

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26 This research adopts an interpretative approach to data analysis, which includes description,
27 classification and connection; categorising and interpreting the data in terms of common themes, and
28 synthesis of data into an overall portrait of the cases (Leedy and Ormond, 2005; Kitchin & Tate,
29 2000). Data analysis involved sorting and categorising a large body of interview transcript data, into a
30 small set of pertinent themes (Leedy and Ormond, 2005). In the thematic analysis, two techniques
31 were chosen for interpretation of the research data; pattern matching and explanation building (Yin,
32 2003). In the case of *pattern matching*, the author examined the collected data to see if they supported
33 the preliminary theoretical framework and associated research questions (Yin, 2003; Whitley, 2002).
34 The research question and sub-questions formed the basis for initially defining the three themes and
35 the subsequent relationship between these themes (connection). In the case of *explanation building*, a
36 particular type of pattern matching, the author used the transcribed data to find emerging patterns or
37 themes, thereby building an understanding of the case (Spencer *et al.*, 2003; Yin, 2003). While the
38 research was framed with a preliminary theoretical framework of learning (**Figure 1**) the interpretive
39 approach allowed for the emergence of themes and sub-themes not originally identified in the
40 interview schedule.
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51 5. Results and discussion

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55 The interpretation of the interview data focussed on the aim of the paper, which is to gauge the likely
56 impact of collecting data for the SAWIS on improving the way waste is managed in South Africa. As
57 such, the results are discussed within the three broad themes. These being: the ability of organisations
58 to collect data; the ability of persons to assimilate and interpret the data; and the ability of persons and
59 organisations to convert this learning to impact.
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5.1 Ability of organisations to collect data

With regards to the ability of organisations 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 interviews and review of documents highlighted that eight of the 12 organisations 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 (**Table 3**). Private waste companies appeared to be generally more successful at collecting data than the public facilities (hospitals and municipal landfills). As noted by a senior provincial official responsible for waste *“for the [private] industries yes we are [comfortable with the reliability and accuracy of the data], cause like it’s a true reflection of what they’re doing”* but *“it’s only the public institutes that are experiencing a problem, they choose any person randomly [and decide] ‘you are going to assist us’ in capturing the data and uploading the data”* (Respondent N, 23/10/2006).

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

Financial reasons for data collection were particularly evident amongst 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 though 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

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3 business purposes also means that data has to be accurate and remain up to date, as stressed by the
4 technical manager of a recycling company “*we know exactly what the waste is because we're paying*
5 *for it, so it's accurate, and it's kept up to date for our own records*” (Respondent M, 1/11/2006).
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10 The importance of data on waste tonnages was also highlighted by all three private landfill operators.
11 As pointed out by the technical manager of a private waste landfill site “*well, we want to reduce our*
12 *waste and if you can save on your waste, you save money. The operating costs at [the] landfill is*
13 *expensive and if we can expand the lifespan of [the] landfill the better for us, we can save a lot of*
14 *money*” (Respondent R, 24/10/2006). The high costs of operating a landfill site were confirmed by
15 another technical manager for waste management and recycling. Their data collection is
16 “*predominantly cost driven, a transport cost and airspace cost and the estimated figures for replacing*
17 *or making a new landfill is just too much to bare*” (Respondent S, 24/10/2006). This drive for data
18 collection in private waste companies is based on a paradigm of financial sustainability. This was
19 emphasised by the manager of a private landfill facility that “*there has to be a cost focus, economic*
20 *focus, very much so, because if you are not performing, then the shareholders want to know why*”
21 (Respondent F, 31/10/2006).
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31 Environmental reporting obligations, e.g. ISO 14000 or reporting to international holding companies
32 was found to be a driver of data collection amongst the majority of private organisations (**Table 3**).
33 The technical manager for an industry running its own private landfill site noted that “*fortunately*
34 *because ISO expects you to have that balance, what's coming in and what's going out, it must balance*
35 *otherwise you can't give evidence of what happens to your waste. And that's where we had to*
36 *implement [data collection] systems to make sure that we comply*” (Respondent R, 24/10/2006). The
37 same respondent also noted the pressure placed on their company from their international parent
38 holding company. The parent company regularly requires information on waste management and
39 sends in audit teams to assess levels of waste management compliance within the organisation.
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47 The third of the sub-themes is the current constraints to data collection within both private and public
48 waste facilities. These constraints to data collection hinge specifically around lack of *equipment*,
49 particularly IT (computers, internet and email connectivity) and *institutional capacity* (availability of
50 staff, the high staff turnover experienced and a shortage of skills within the organisations to collect
51 and interpret the data) (**Figure 2**). The constraints created by a *lack of equipment* and *institutional*
52 *capacity* are not unique to this study but were also found in an independent research project conducted
53 by the author, on challenges facing local government, which adopted a systems approach to exploring
54 institutional constraints facing waste management in local government (Godfrey & Oelofse, 2008).
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3 Equipment constraints hinged around two specific issues, the lack of computers, email and internet,
4 typically within municipalities, and the lack of weighbridges at landfills to capture data on waste
5 entering facilities. The lack of IT equipment appeared largely to be a problem within municipalities in
6 both provinces, as noted by Respondent N (23/10/2006): “[the] *challenge which I think is going to be*
7 *dealt with by other municipalities, they don’t have internet, they don’t even have a computer. For*
8 *other municipalities, I foresee problems if they are not going to have computer systems.”* Officials
9 within municipalities were often found not to have computers, and where they did have computers,
10 they did not have email or internet connectivity (Respondent A, 30/10/2006; Respondent N,
11 23/10/2006). This makes the transfer of data to the SAWIS difficult, and often means that data has to
12 be transferred in hardcopy by fax or mail, which has the potential to negatively impact upon data
13 analysis and interpretation.
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23 A further constraint is the lack of equipment at waste facilities for accurately recording tonnages of
24 waste, e.g. weighbridges (Respondent A, 30/10/2006; Respondent B, 30/10/2006). This impacts upon
25 the reliability and accuracy of data collected for the system, which impacts upon the quality of use of
26 the data (**Figure 2**).
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31 From the interview data, institutional capacity was seen as a predominant constraint within
32 municipalities. This lack of capacity, but particularly the lack of experienced and skilled capacity,
33 within government has been recognised locally and internationally (Le Roux, 2004; Moeletsi &
34 Novella, 2004; CEC, 2004; Sissell, 1998) as a constraint to successfully implementing waste
35 information systems. The need for capacity building in government and reporting industries is
36 recognised as a priority for successful system implementation (IFCS, 1997). One of the reasons for
37 this lack of capacity is the high turnover of government officials (Nauman, 2004), a challenge
38 currently facing South Africa (Godfrey, 2007), and confirmed by respondents in both provinces. A
39 provincial waste officer observed that “*the people that are collecting [the data], today they’re in,*
40 *tomorrow they’re out. So there’s no consistency*” (Respondent N, 23/10/2006). The manager for waste
41 in the province also noted that “*the turnover is ... just unbelievable of staff within the department,*
42 *especially at a regional level.”* (Respondent C, 30/10/2006). The same manager also noted that the
43 turnover of staff was found to impact negatively on the implementation of the SAWIS in that “*the*
44 *change of guys within the district municipalities... sometimes it’s unfortunate that you’ll be working*
45 *with someone on that particular project such as this, and then there is an election and then you have*
46 *new guys and there is no continuity*” (Respondent C, 30/10/2006).
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59 It is not only having all available positions filled that is important, but also having staff with the
60 appropriate technical skills. According to the manager for municipal solid waste in one of the local
municipalities “*the challenge [of data collection] is still with us in terms of technical skills and*

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3 *approach because we don't have the adequate resources"* (Respondent P, 23/10/2006). This lack of
4 skilled capacity within public facilities was also identified by the provincial waste officer where he
5 found that *"people that are collecting [the data], [some] they don't even have [Grade 7], others they*
6 *don't even have [Grade 4]. So they're just the cleaner"* (Respondent N, 23/10/2006). This lack of
7 skilled capacity at waste facilities was seen to impact upon issues as simple as staff not being able to
8 identify the type of waste being generated or received, or estimating the tonnages of waste carried by
9 vehicles entering municipal landfill sites (Respondent A, 30/10/2006).
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15 16 5.2 Ability of persons to assimilate and interpret the data 17 18

19 The second theme is around the ability of persons to assimilate and interpret the collected waste data,
20 building knowledge through a process of learning, which would give them the ability to act. The
21 interviews revealed three sub-themes: evidence of data interpretation; data not used; and poor
22 understanding of data use (**Figure 3**). With regards to the first sub-theme, the interviews showed that
23 in instances, respondents have assimilated and interpreted the collected waste data, and in so doing,
24 recognised areas of intervention, or possible uses of the data to improve the way in which waste is
25 managed within the facility. Evidence of particular applications of the information, include managing
26 the vehicle fleet; planning for current and future waste facilities; costing of operations; and ongoing
27 site operation and maintenance.
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35 In one instance, a municipal landfill site had records on vehicles entering the landfill for the first time
36 since data collection for SAWIS began. The assimilation and interpretation of the collected data is
37 evident in the information provided by Respondent O (23/10/2006) *"I can see now why is this vehicle*
38 *for the time not entering the site. Then I see, it's broken down and they didn't fix it. I told () the other*
39 *day, now we can see the management side of the vehicle maintenance"* (Respondent O, 23/10/2006).
40 This information on vehicles entering the site provided the same respondent the opportunity to monitor
41 the operation of their transfer station. *"I know now for a fact, the transfer station is not operating*
42 *properly for the last month, because all the rear end compactors [are] going out to the landfill site.*
43 *And that's a lot of extra cost. Now normally on our landfall site it's only the garden refuse trucks and*
44 *the roll on vehicles [which are] supposed to enter the landfill site, now all the tractors and trailers and*
45 *everything is now entering the landfill site".* The interpreted data also provided the municipal official
46 with trends in the different types of waste entering their landfill site. *"But what is nice, you can see the*
47 *trends in the winter months, the garden refuse is much lesser than the summer months. The building*
48 *activities, it's much higher in the first six months of the year, especially on building rubble than the*
49 *last 6 months"* (Respondent O, 23/10/2006). Respondent O (23/10/2006) also noted that the limited
50 data the municipality had to work with prior to the SAWIS pilot project had been a 'thumb suck'.
51 This lack of reliable waste data in the municipality prior to the SAWIS, and the noted applications of
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3 the data now being collected, was pointed out by the provincial waste officer: “[the local municipality]
4 was not having this data, it was only estimations and projections that they were making in accordance
5 to the population, but now it’s much simpler, now they know how much is it. So for the new landfill
6 site, they know how much airspace they have to prepare” (Respondent N, 23/10/2006).
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11 Many municipal landfill sites are currently not charging for waste disposal, due to a lack of capacity or
12 fear of increased illegal dumping (Godfrey & Nahman, 2008; Godfrey & Oelofse, 2008). While all
13 participating private landfill sites, and those in the larger metropolitan municipalities were charging
14 for the disposal of waste at the time of this research, one of the local municipalities which participated
15 in the pilot did not charge. Because of data collection for the SAWIS, this municipality was now
16 looking into disposal tariffs for the new planned landfill site. Respondent O (23/10/2006) felt that for
17 the first time they now know “the tonnage [of waste] that’s going in, so [how] much we must ask per
18 ton, to balance the books of the new landfill site”.
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26 The application of data for site operation was identified by respondents from both public and private
27 waste facilities. Operational issues for landfill sites centred on managing remaining airspace in
28 landfill sites (Respondent O, 23/10/2006; Respondent R, 24/10/2006; Respondent S, 24/10/2006) as
29 well as planning the airspace needs for future planned landfills (Respondent O, 23/10/2006).
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34 The interviews similarly highlighted the fact that some organisations do not use the data after having
35 collected it, and therefore have no concept of the usefulness of having the data available to them, or
36 alternatively have a poor understanding of the potential use of this data. The technical manager of a
37 waste recycling company that previously commented on the importance of collecting data as part of
38 their business accounting systems, later pointed out that he “personally [doesn’t] use [the waste data]
39 for anything else, the only reason I ever request it is for the reporting [to SAWIS] and I know that it’s
40 not something that is reported on regularly because whenever I ask [my company] to provide me with
41 it, they’ve got to go and run reports. Download it, collect it, they don’t have that information on
42 hand” (Respondent H, 31/10/2006).
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50 5.3 Ability of persons and organisation to convert this learning to impact

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53 The third theme revealed in the data is the ability of persons and organisation to convert learning to
54 impact, and in so doing bring about change in the way waste is currently managed. The interviews
55 highlighted few areas of direct positive impact leading from the SAWIS data collection, as well as
56 areas of no or little noticeable impact in operations (**Figure 4**).
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3 Positive impacts noted by respondents included the placement of new staff at landfill sites to improve
4 the flow of vehicles onto the site, thereby freeing up existing staff to collect the required data. In one
5 particular case, the security guard at the entrance of the landfill had previously been tasked with both
6 directing vehicles to the tipping face as well as collecting waste data (Respondent B, 30/10/2006).
7 The data also revealed a more aggressive drive towards finding new sources of recyclables for one of
8 the recycling companies (Respondent M, 1/11/2006). However, since data showed that all
9 participating private waste companies had already been collecting data prior to the SAWIS, it is
10 difficult to distinguish the impact of the SAWIS data collection from that already implemented
11 through existing management practices.
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19 According to the provincial waste officer (Respondent N, 23/10/2006) the collection of data by the
20 municipality has not had any positive impact on landfill management "*cause like if it did really, they*
21 *would have even put a new fence up*". Even at the public hospitals, data collection has had no impact
22 on waste management: "*No ways, no difference [at the hospitals]. It's just that they're collecting it*
23 *because we want that information. So like, they're not utilising it for any of their benefits*" (Respondent
24 N, 23/10/2006).
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31 In instances, collected data was not being used at all after submission to the SAWIS, with no potential
32 to generate knowledge or cause change. As pointed out by the technical manager of a waste treatment
33 facility, I've "*no [use for the data] at the moment, but I've got it there should we [need it]*"
34 (Respondent Q, 23/10/2006). This was confirmed by a respondent from provincial government who
35 also noted that the data "*was not necessarily [being used] right now*" (Respondent A, 30/10/2006)
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41 This raises the question as to why in certain circumstances individuals with acquired knowledge act on
42 that knowledge to implement changed waste practices, while in other instances, this acquired
43 knowledge does not lead to impact? According to Miller & Morris, (1999:74) "there is a commonly
44 held myth that providing individuals or groups with information will lead them to appropriate personal
45 and organizational actions and performance, but this is far from true." According to Pfeffer and Sutton
46 (2000), while information and knowledge are 'crucial to performance', knowledge of an issue is often
47 not sufficient to cause action: "*there is only a loose and imperfect relationship between knowing what*
48 *to do and the ability to act on that knowledge.*" (Pfeffer & Sutton, 2000:25). This frequent inability to
49 transfer knowledge of what needs to be done into action or behaviour which is consistent with that
50 knowledge, is referred to by Pfeffer & Sutton (2000) as the 'knowing-doing gap' or the 'performance
51 paradox' (Cohen, 1998 in Pfeffer & Sutton, 2000). While it was believed that the 'knowing-doing gap'
52 was due to a lack of personal knowledge or skills, research conducted by Pfeffer & Sutton (2000)
53 suggests that while personal knowledge is important in ensuring action, it is not as important as having
54 management systems and practices in place. According to Pfeffer & Sutton (2000) the gap between
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3 knowing and doing is more significant than the gap between ignorance and knowing. This is due to
4 the fact that considerable knowledge already exists, which is either already known to an individual, or
5 can be readily sourced, yet lack of implementation persists.
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10 This lack of impact from waste data collection to changed waste practices may result from a
11 communication ‘gap’ between those who collect and interpret the data, and those who have the
12 responsibility and ability for decision-making and effecting change. This is evident in the response
13 provided by a municipal officer: *“I send [management] the monthly data sheet. I don’t know if they*
14 *look at it at all, but I send it through to them as well”* (Respondent O, 23/10/2006). The result is that
15 data collection may generate knowledge, but not at the point of decision-making within the
16 organisation.
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22 The interviews also highlight a number of external factors which make it difficult for staff within
23 municipalities and private waste companies to use data to improve the management of waste. These
24 external factors hinge around governance, due particularly to the low priority often given by
25 politicians and senior government officials to waste in South Africa (politics, bureaucracy and
26 procurement). According to Howes (2001), the long-term sustainability of any pollutant and waste
27 information system is dependant foremost upon the political will of the country to support such
28 initiatives:
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36 *“But again it’s this political willingness to turn things around at a local level, I mean its*
37 *worse at a local level than it is at provincial level. If there is no political buy-in on any*
38 *activity it will not fly at a local level and that’s just a reality. All these processes must have a*
39 *political endorsement through their councils before it moves otherwise it just doesn’t go”*
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42 (Respondent C, 30/10/2006).
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46 The external influences and apparent frustrations of politics, bureaucracy and procurement were only
47 noted by respondents from municipalities and not from private waste companies. Long approval
48 processes and the centralisation of decision-making to councils and municipal managers were noted by
49 waste officials:
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54 *“It becomes difficult to go around the bureaucracy [in the municipality], because sometimes*
55 *it has to go through the municipal manager for signature, before it goes to him, he [wants] to*
56 *make sure that a legal adviser is happy with the content and then once they are happy with*
57 *that, then it must go through the council, and it takes months”* (Respondent B, 30/10/2006).
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3 The frustration experienced by municipal waste officers who need to wait for lengthy bureaucratic
4 approval processes was noted by Respondent C (30/10/2006): *“they still haven’t come back to us so I*
5 *understand there are processes because its tied in with the political process at a local level and it gets*
6 *frustrating I know for [the municipal officials responsible for waste] who like to do this but their hands*
7 *are tied”* (Respondent C, 23/10/2006).
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13 Another external factor is the strong influence of unions on municipal workers. A provincial officer
14 stated that: *“[data collection] is putting more pressure on the people that are collecting it from the*
15 *[hospital] ward. And then they're asking us, did we talk to the unions that we adding more*
16 *responsibilities, because their duties [are] to get in and collect [the waste] and put it aside. But we say*
17 *it’s not an additional job, it’s what the hospital was supposed to do”* (Respondent N, 23/10/2006).
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23 While the responsibility for decision-making about waste is often elevated to council and the
24 municipal manager, accountability for action remains with the subordinate waste officials and line
25 managers. A manager for municipal solid waste expressed his frustration by stating: *“I know that its*
26 *not because of me, its because of the internal bureaucracy that does not allow me to implement that,*
27 *so maybe certain instances where I say I need a person to do one, two, three that person could not be*
28 *appointed. But when you audit me, you audit me as if I failed to do my work, not knowing why I*
29 *couldn't implement the Act”* (Respondent P, 23/10/2006).
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35 Similarly, the ability to procure services has been removed from line staff, making it difficult for them
36 to implement the necessary changes in waste management through appointment of contractors, or
37 purchase of equipment: *“I can tell you, procurement is a nightmare, it’s a nightmare. In the past I*
38 *could obtain quotations from the best people to do the job. Now we can't even ask for quotations.*
39 *People from the first floor, clerks gonna get the quotations. They’re gonna get the quotations, they’re*
40 *gonna award it, you’re not gonna have any say in it”* (Respondent O, 23/10/2006)
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47 While little direct evidence was provided by respondents for resultant changes directly due to data
48 collection, the reasons and influences for no or limited change were perhaps more insightful into
49 understanding the research question, and in particular the constraining factors external to the
50 individual.
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54 55 **6. Conclusions**

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58 Previous research has shown that the need for waste data in South Africa reflects “greater, currently
59 unfulfilled needs in the sustainable management of waste in South Africa. These needs, which, if
60 fulfilled through reliable, accurate waste information [have] the potential to lead to the improved

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3 management of waste in South Africa” Godfrey (2008:1667). This conclusion formed the basis for the
4 research question explored in this paper: “Can the collection of data for a national waste information
5 system, change the way waste is managed in South Africa, such that there is a noticeable
6 improvement?” The research question was explored in this paper through a preliminary theoretical
7 framework of learning (Miller and Morris, 1999).
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13 The research addressed three sub-questions which formed the basis for defining the initial themes used
14 to analyse and interpret the interview transcript data: Do organisations have the ability to collect data?
15 Do persons have the ability to assimilate and interpret the data? Do persons (and organisations) have
16 the ability to convert this learning into impact (potential to implement change in managing waste)?
17 Applying a qualitative, interpretative approach provided an opportunity to identify further sub-themes
18 which emerged from the interview data (**Figure 5**).
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24 In terms of *theme 1, the ability to collect data*, the interviews highlight differences in an organisation’s
25 ability to collect data, with private waste companies having successfully implemented waste data
26 collection systems. It is evident that there are external factors, or drivers, which have resulted in these
27 organisations already implementing data collection systems well before the piloting of the SAWIS.
28 The main drivers were found to be financial sustainability e.g. revenue recovery (billing) and reduced
29 operational costs; and environmental reporting obligations e.g. ISO14000, particularly where the
30 company had an international parent company. However, participants also highlighted the current
31 constraints to data collection, typically within public waste facilities, specifically focussing on the lack
32 of equipment, particularly IT (computers, internet and email connectivity) and lack of capacity
33 (availability, turnover, skills) to collect and interpret the data. These constraints are not however
34 unique to waste data collection and utilisation, but constrain municipalities in terms of broader waste
35 service delivery issues (Godfrey & Oelofse, 2008).
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46 The data showed that in terms of *theme 2, ability to assimilate and interpret data*, certain persons
47 interviewed have assimilated and interpreted the waste data collected for SAWIS, utilising this data to
48 inform and manage the organisations operations, including vehicle management; facility planning,
49 costing of operations, and ongoing site operation and maintenance. The result is that certain persons
50 and organisations have been able to use the data and convert this learning to impact (potential to
51 implement change in managing waste) leading to changed practices within the organisation.
52 Similarly, there are organisations that do not use the data after having collected it, and therefore do not
53 see the usefulness in having the data available to them, or have a poor understanding of the potential
54 use of this data, resulting in no or little noticeable impact on operations.
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3 It was also found that in terms of *theme 3, ability to convert learning to impact*, little evidence was
4 found for resultant change in waste practices as a result of data collection during the piloting of the
5 SAWIS. While the desire may exist within individuals to implement change based on this raised
6 awareness around waste management practices, the point of knowledge generation may be removed
7 from the point of decision-making within organisations due to a break in communication, or may be
8 constrained by organisational bureaucracy and administrative procedures. These external factors have
9 made it difficult for persons, particularly within municipalities to both collect waste data, or from the
10 raised awareness associated with the interpretation and internalisation of data, to implement the
11 necessary changes within their organisation. These external factors hinged largely around governance.
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19 While the preliminary theoretical framework of learning provided a means for interpreting the
20 interview findings, the results showed that knowledge is a necessary but insufficient condition for
21 resultant action. The conceptual framework of learning was shown to be simplistic for understanding
22 the role of waste data in a developing country context such as South Africa, and did not account for
23 external influences. It is proposed that further research is necessary to establish a more conceptually
24 inclusive framework, which explains the complex nature of learning, behaviour and potential for
25 action and impact from environmental information, and specifically waste information, within the
26 South African context.
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Interviews

Respondent A. (30 October 2006). Provincial manager: Waste Management

Respondent B. (30 October 2006). Municipal Assistant Manager: Waste Management

Respondent C. (30/10/2006). Provincial manager: Waste Management

Respondent D. (30/10/2006). Administrative clerk

Respondent E. (31/10/2006). Municipal officer: waste information

Respondent F. (31/10/2006). Manager: landfill facility

Respondent G. (31/10/2006). Administrative clerk

Respondent H. (31/10/2006). Technical Manager: Waste Recycling

Respondent J. (31/10/2006). Manager: waste recycling facility

Respondent K. (31/10/2006). Administrative clerk

Respondent L. (1/11/2006). Manager: Waste recycling facility

Respondent M. (1/11/2006). Technical Manager: Waste Recycling

Respondent N. (23/10/2006). Provincial Waste Officer

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Respondent O. (23/10/2006). Municipal officer: waste information and recycling
Respondent P. (23/10/2006). Manager: Municipal solid waste
Respondent Q. (23/10/2006). Technical Manager: Waste treatment facility
Respondent R. (24/10/2006). Technical Manager: Waste Landfill
Respondent S. (24/10/2006). Technical Manager: Waste Landfill and Recycling

For Peer Review

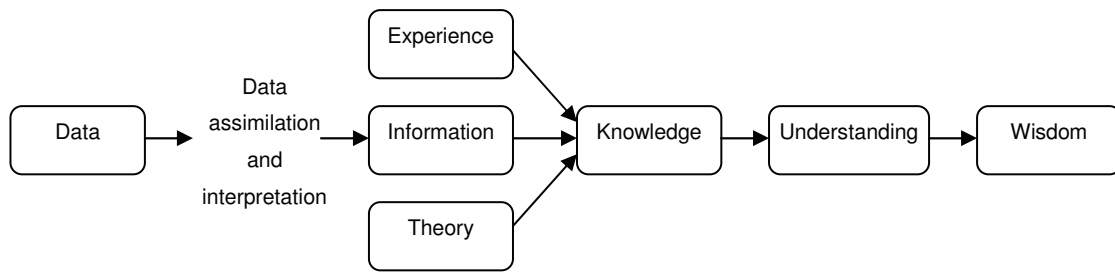


Figure 1. Process of learning (adapted from Miller & Morris, 1999).

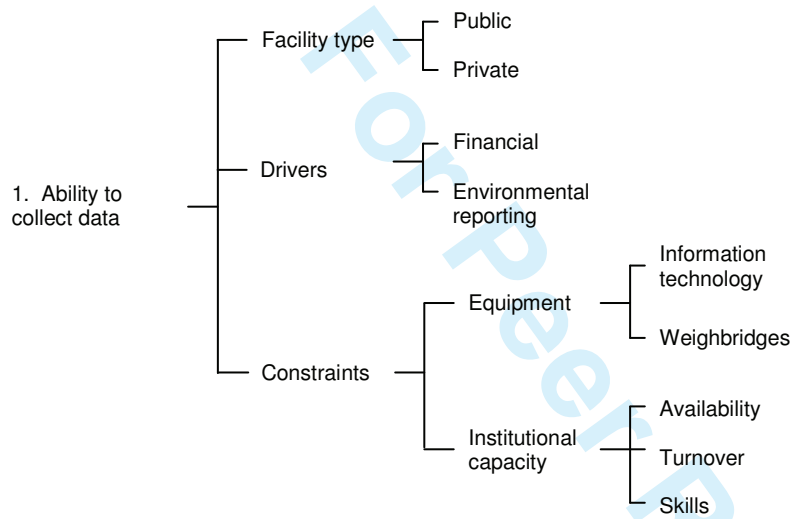


Figure 2. Theme 1: The ability of organisations to collect data

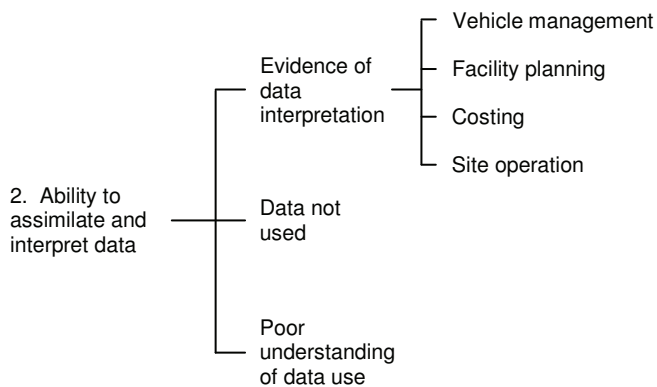


Figure 3. Theme 2: The ability of persons to assimilate and interpret the data

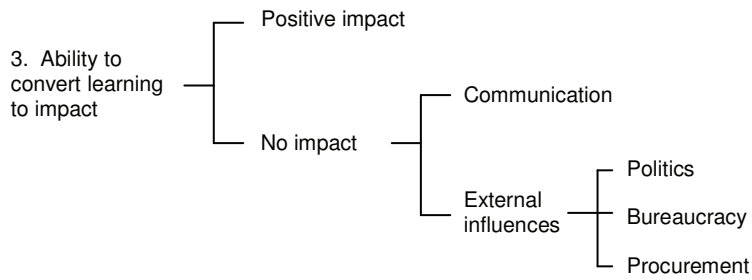


Figure 4. Theme 3: The ability of persons and organisations to convert learning to impact

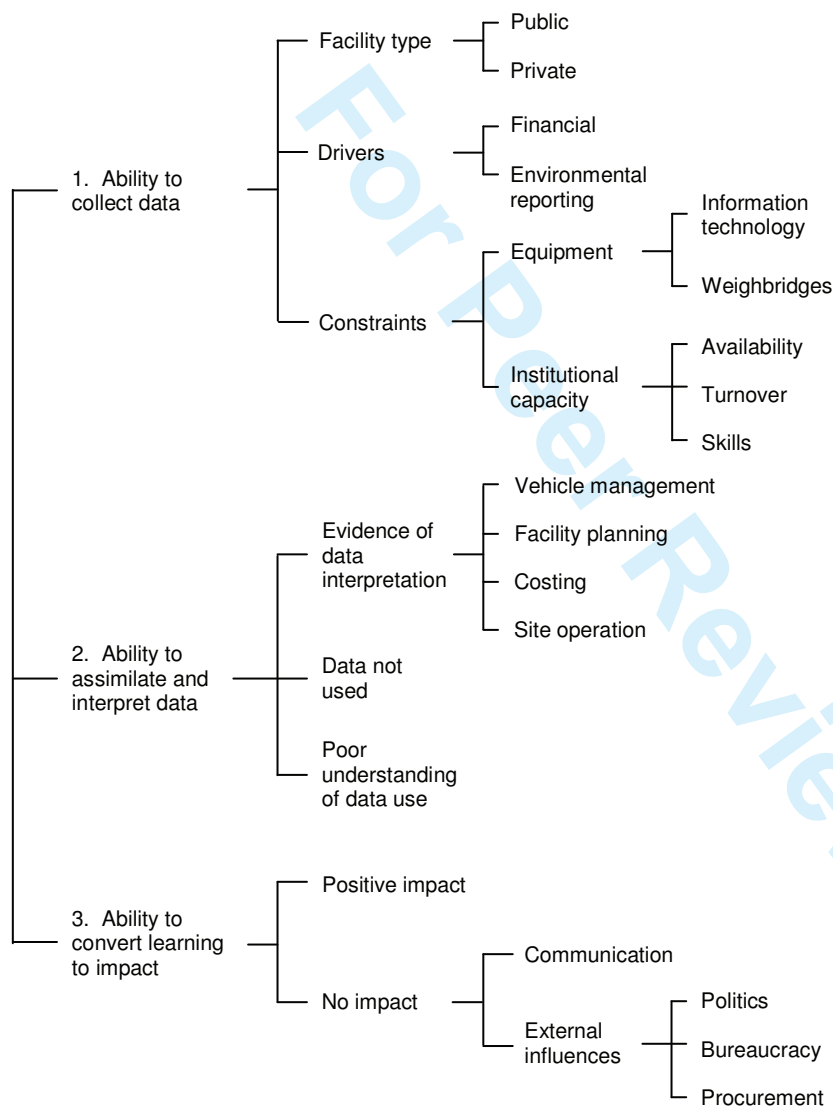


Figure 5. Summary: The ability to change the way waste is managed through data collection

Table 1. Selection criteria for SAWIS pilot provinces and municipalities (adapted from Borg *et al.*, 2004; Fischer & Godfrey, 2005)

<i>Institutional requirements:</i>	
•	Political support
•	Resources
•	Support
•	Time frames
•	Communication
<i>Technical requirements:</i>	
•	There should be at least one G:M:B or G:L:B landfill ⁽¹⁾ in the province
•	There should be at least one hazardous landfill site or treatment facility in the province
•	A large percentage of landfills in the province should have weighbridges
•	A reprocessing facility for one of the identified priority recyclable waste streams (paper or plastic) should be located within the province

Table 2. 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

¹ G:M:B – General landfill site of medium size (150-500 T/d maximum rate of deposition); G:L:B – General landfill site of large size (>500 T/d maximum rate of deposition).

Table 3. 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
	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