A generic air quality management plan for Municipalities

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ABSTRACT

Air quality management in South Africa has undergone drastic changes since the implementation of the National Environmental: Air Quality Act (Act 39 of 2004). The new Act shifts the emphasis from point-source control to proactively protecting the receiving environment. In keeping with the new approach, it is a legal requirement that Municipalities must compile and implement air quality management plans (AQMPs) as part of their Integrated Development Plans (IDPs). Although an explicit requirement of the Act, no clear guidelines exist for regulating bodies, including Municipalities, regarding the contents of such plans.

The main findings of the study revealed a lack of air quality management infrastructure and a shortage of experienced, qualified staff to develop, implement and maintain air quality management plans. Financial constraints were also identified as a big concern to manage air quality. Although it is an explicit requirement by the Act, very few municipalities have approved AQMPs, nor appointed air quality officers. A generic air quality management plan framework (AQMPF) for all tiers of government was developed to assist regulating authorities when compiling air quality management plans. Although generic, this AQMPF was found to be applicable to Municipalities as well. Due to the fact that a lack of training has been identified as a critical gap in the successful implementation and maintenance of an AQMP, this study makes a significant contribution to the identification of generic training outcomes.

INTRODUCTION

Air quality problems have been an inescapable partner of global economic development and such problems have prevailed since the industrial age. As the impact of air pollution is increased by the availability of technology, the interaction between these issues is dynamic. Social, political and economic responses to air pollution have often lagged behind. Public awareness, understanding of the impact of air pollution and the public's willingness to accept a particular level of pollution has changed over time. The ability and willingness of political institutions to address air pollution varies depending on the level of public concern, the economic costs of change, the impacts of air pollution and the availability of technological solutions (Longhurst *et al.* 2004:1).

According to Longhurst *et al.* (1996:3975), economic, political, social and technological actions and reactions were traditionally considered to reduce levels of pollution, whilst minimising the adverse consequences of control on business and society at large. However, the reaction has not always been appropriate or timely, particularly in the case of air pollution in urban areas where a city's form and functional topography predispose it to air pollution.

A number of air pollution incidents were recorded where air pollution levels led to fatalities. One such episode in the United Kingdom (UK) in 1952, contributed to the death of more than 4 000 people. The cause of this incident was a combination of stable atmospheric conditions accompanied by high levels of air pollutants (National Society for Clean Air and Environmental Protection. 2006:68). As is often the case in environmental matters such an acute impact was the motivation for legislative control. The statutory basis for this pioneering legislation was to control certain point sources of air pollution, the so-called "bad polluters". Unfortunately, this level of control did not adequately improve air quality in inner cities and urban environments. The improvements were observed mainly in industrial areas where industries that emit pollutants through point sources were located.

In the early 1990s it was internationally acknowledged that the solution to increasing levels of air pollutants lay in a holistic effects-based approach. A risk management process was used to provide dynamic solutions to environmental health issues that were associated with elevated concentrations of air pollutants (Longhurst *et al.* 2004:1). Legislation provided a framework in which national and local actions were mounted to identify and remediate areas of poor air quality. The UK took the lead in the world by promulgating legislation for the air quality management process, through the Environment Act of 1995. This Act prescribed an air quality strategy that enabled the Government to introduce a series of air quality objectives, for the purpose of Local Air Quality Management, for lead, carbon monoxide, butadiene, sulphur dioxide, nitrogen dioxide, benzene and particulate matter smaller than 10 microns (PM_{10}).

In South Africa, prior to 1965, air pollution control was implemented by "nuisance by-laws" that were promulgated and enforced by local authorities. Due to the increase in complicated industrial processes that added new air pollutants to the atmosphere, it became clear that regulation through by-laws was not effective, especially in a country such as South Africa where fossil fuel from coal is produced on a large scale. A significant proportion of coal mined is of an inferior quality with a high sulphur and ash content contributing to the air pollution potential. The majority of this inferior quality coal is consumed by low income communities who use it for energy to prepare food and for heating of living areas. As coal combustion led to high levels of pollutants in densely populated areas, it became clear that more advanced legislation was needed to regulate air pollution in South Africa. The Atmospheric Pollution Prevention Act (APPA) was promulgated. It made provision for the following air pollution criteria (1965:1):

- Control of certain industrial processes using a registration process
- Proclamation of designated smoke-control areas
- Control over diesel vehicle-emissions
- Dust control in proclaimed areas

After the democratisation of South Africa, the government embarked on a law reforming process to bring all the laws of the country in line with the new Constitution of South Africa. This process included environmental legislation. An important directive in the White Paper on Integrated Pollution and Waste Management for South Africa (SA, 2000) was to ensure an integrated approach to environmental management. The reasons for air pollution legislation being seen as outdated were:

- Not all the control of air pollution was the responsibility of local government as stipulated in the Constitution of the Republic of South Africa. In terms of Section 155(6)(a) and (7) of the Constitution, air pollution is regarded as a local government matter and therefore it has to be managed by Municipalities.
- Legislation focused on point source control with a reactive approach to air pollution
- International air pollution issues were neither addressed nor controlled
- Participative approach of stakeholders to air pollution control was non-existent
- The approach was based on a reactive rather than a proactive approach
- Responsibilities for air quality management of the receiving environment was undefined

The review process of APPA was completed during

2004 and the National Environment Management: Air Quality Act (NEM:AQA) (2004:1) was approved by Parliament in August 2004. This Act, a first in South Africa, reforms the law regulating air quality to protect the environment. It provides reasonable measures for the prevention of pollution and ecological degradation, and for securing continued ecologically sustainable development. At the same time it promotes justifiable economic and social development, by providing for national norms and standards to regulate air quality monitoring, management and control by all spheres of government, for specific air quality measures and for matters incidental thereto.

One of the main aims of the Act is to ensure proper institutional and planning procedures. In terms of Section 15, national, provincial and municipal governments are required to prepare and implement air quality management plans. These plans also need to be revised and reported regularly. Section 16 of the Act gives broad direction only on the content of such plans. Such plans will form the basis for the demarcation of priority areas where air quality does not meet the acceptable standards. Action plans need to be submitted by regulating authorities responsible for such priority areas (NEM:AQA). Industry is also required in terms of Sections 29 and 30 of NEM:AQA to submit, if requested, pollution prevention plans as well as atmospheric impact reports.

The aim of this study was to develop a Framework for a generic AQMP guideline document for the three tiers of government to improve understanding of documenting and implementing AQMPs at Municipalities. The input from heavy industry formed an integral part of the research, because municipal AQMPs need to include the needs of industry and industry needs to implement actions of the plans approved by municipalities.

MATERIALS AND METHODS

Literature survey

A literature survey on the status quo of AQMPs in five countries around the world was conducted to provide the basis for the compilation of the questionnaires used in a national survey. Two countries, the UK and the USA were selected because of improvement in air quality due to the implementation of AQMPs. Two other countries namely China and Mexico, where air quality has deteriorated despite the implementation of air quality management measures, were also included in the literature study. A study on the status quo of AQMPs in the RSA was conducted to conclude the literature study. Four AQMPs from the Metropolitan Councils of Tshwane, Joburg, Ekurhuleni and Cape Town respectively were assessed. Best practice in air quality management derived from the literature study was considered when compiling the questionnaires.

Table I represents a summary of the critical elements of AQMPs where implementation has led to improvement in air quality. The critical elements of the AQMPs of the UK, USA, China, Mexico and RSA are compared. (Table next page).

It is known from the literature study that the air quality of China and Mexico is poor when compared to the UK and USA. Therefore, elements which are found in AQMP's of both the UK and the USA, but which are absent from AQMP's of China and/or Mexico could therefore be regarded as imperative to ensure air quality improvement. These elements are:

- Air quality monitoring
- Air quality standards and guidelines
- Simulation (dispersion) modeling
- Public information and dissemination
- Planning and air quality management

On the other hand, an enforcement programme which is present in both Mexico and China, but absent in the UK and the USA, didn't have any positive impact on air quality. With regard to South Africa's AQMP, is clear from Table I that the following elements, which are critical success factors in the UK and the USA, are absent:

- air quality monitoring
- public information and dissemination
- Planning and air quality management

These success factors need to receive priority attention in the South African air quality

TABLE I: Comparison of critical elements of AQMPs of the UK, USA, RSA, China and Mexico

Element	UK	USA	RSA	China	Mexico
Air quality goals and objectives	√	-	√	-	√
Source inventories and emission quantification	√	-	√	√	-
Air quality monitoring	√	√	-	-	√
Air quality standards and guidelines	√	√	√	-	√
Simulation (dispersion) modeling	√	√	√	-	-
Public information and dissemination	√	√	-	-	-
Air quality alert	√	-	-	-	-
Planning and air quality management	√	√	-	-	-
Enforcement programme	-	√	-	√	√
Source control (national and international)	-	√	√	-	-
Staffing, funding and authority confirmation	-	√	√	-	-
Plan revision process	-	√	√	-	-
Energy conservation	-	-	-	√	-

management planning in the future while not negating other elements identified in Table I, which are off course all important for effective air quality management. Proper source inventory and emission quantification as well as air quality standards and guidelines seem to be the most important elements that were implemented by "successful" countries. Energy conservation is currently the least implemented but will have to receive more attention due to the ratification of the Kyoto Protocol by South Africa.

Table II provides a summary of the reasons for air quality management planning in the four countries investigated not achieving positive results.

The blank spaces (-) presented in Table II indicate that no specific indication was present in the literature survey to conclude that it was seen as a problem. It should be noted that not one of the countries investigated demonstrated full compliance to air quality standards. In the UK and USA, this can be attributed to legislative and institutional barriers, since this is the only limiting parameter present in both the "successful" countries. However, elements that contributed to the failure of AQMP's to achieve the required results in Mexico and China are the following:

- Perception barriers
- Local analytical / technical capability
- Limited rule of law
- Absence of public participation
- Management of point sources only

These factors should be noted by South African Air quality managers and avoided if an improvement in air quality is to be achieved.

Selection of population

District Municipality and Metro level of local government (AQMPs are the responsibility of aforesaid in terms of NEM:AQA) were included in the study. The questionnaire was sent to the Municipal Manager who was requested to assign it to the officer responsible for air quality

TABLE II: Comparison of reasons for failure of AQMPs

Element	China	Mexico	UK	USA	RSA
Political impracticability	√	-	-	-	√
Legislative and institutional barriers	√	-	√	√	-
Perception barriers	√	√	-	-	-
Local analytical / technical capability	√	√	-	-	-
Limited rule of law	√	√	-	-	-
Reactive control	-	√	-	-	√
Absence of public participation	√	√	-	-	√
Management of point sources only	√	√	-	-	-
Absence of prioritisation	-	√	-	-	√
Air quality standards not met	√	√	√	√	√

management. If such officer was not employed at the metro/district municipality the questionnaire made provision for the identification of any official to complete the questionnaire. The total population (N=54) surveyed included six metropolitan municipalities and 48 district municipalities.

Materials

As a point of departure, when drafting the contents of the questionnaire for the Municipalities, the minimum requirements as laid down for AQMPs in section 16(1) of the NEM:AQA were used. Details of other roles and responsibilities as contained in the NEM: AQA were included in the questionnaires. Best practices, namely critical elements, identified during the literature study from the UK and USA, were also, as discussed in more detail above, included. The questionnaire was constructed to include: nominal data; Lickert scale responses on a four-point scale; and open-ended questions. The questionnaire covered the following aspects: geographical information, status on the air quality management policy and framework, air quality management plan, capacity and air quality monitoring

Method

Pre-testing was conducted by sending the questionnaire to persons (n = 7) that did not form part of the study population, for comment. Comments received were evaluated and where applicable, changes were made to the questionnaire. A structured questionnaire was sent to the district municipalities and metros. Raw data from each of the questionnaires were coded using the Microsoft Excel software program. The coded data were then transferred and imported into the SAS statistics programme. Frequency tables were used to process the results.

RESULTS

Demographics

Demographics are important as some of the areas in provinces such as the Gauteng and KwaZulu Natal provinces are known to be highly industrialised (notably the Vaal Triangle and the Durban basin) and will need special attention as far as air quality management is concerned. Some of the municipalities may be situated in an airshed to be proclaimed as a priority area that also needs

special air quality management initiatives.

Nineteen responses were received from a total population of fifty four. In Table III the highest response rate was from municipalities located in the Gauteng and Eastern Cape provinces respectively (5 questionnaires each). No response from any municipality in the Limpopo and North West provinces was received.

TABLE III: Provincial location of Metros and District Municipalities (n=19)

PROVINCE	NUMBER OF RESPONCES RECEIVED
Gauteng	5
Mpumalanga	1
KwaZulu Natal	3
Eastern Cape	5
Free State	1
Northern Cape	1
Western Cape	3
Limpopo	0
North West	0

Table IV reflects that the response rate for Municipalities (Metros and District Municipalities) was 35%. Only two metros, the eThekwini (Durban) and Joburg (Johannesburg) Metros did not respond. An overall response rate for metros was 67%. The response rate of District Municipalities was 31%.

Table V indicates that the feedback from the Environmental Health Departments at municipalities was the highest (89%). No feedback was received from the functionaries of the Departments of Town Planning, Housing and Transport respectively. One questionnaire that was returned had been completed by the Community Development Department of the municipality.

TABLE V: Department(s) that respondents represented (n=19)

DEPARTMENT	NUMBER
Environmental management	1
Environmental management & environmental health	1
Environmental health	16
Community development	1

Air quality management capacity

Air quality management capacity represents specific technically skilled human resources, a dedicated infrastructure as well as adequate financial resources to manage air quality properly.

Figure I reflect the status of appointment of air quality officers for municipal government. The appointment of such officers at municipal level is a legal requirement in terms of NEM:AQA. For municipalities 18% indicated that they had appointed officers. Two respondents did not complete this section of the questionnaire, therefore n=17

TABLE IV: Responses from Metros and District Municipalities

	N Sent	N Undelivered	N Returned	Percentage Response
Metros	6	0	4	67
District Municipalities	48	0	15	31
TOTAL	54	0	19	35

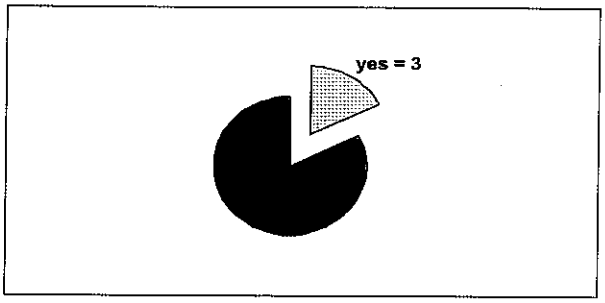

FIGURE I: Appointment of air quality and air pollution control officers (n=17)

To assist with the effective development, implementation and maintenance of an AQMP, a dedicated air quality management section is imperative. Unique technical skills and competencies are needed for effective management. Figure II represents the responses indicted that a dedicated air quality management section existed in only four (21%) municipalities.

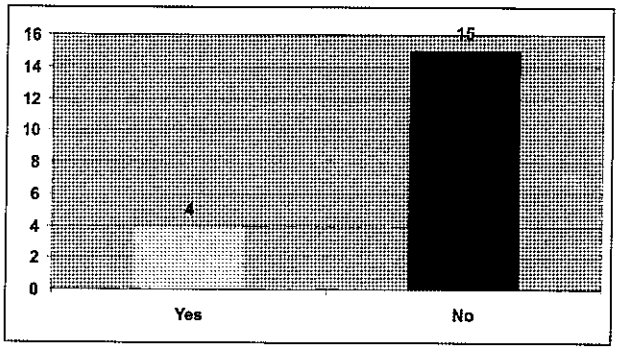

FIGURE II: Dedicated air quality management section (n=19)

Air quality management technical capacity

Due to the fact that it is a legal requirement in terms of NEM: AQA to develop AQMPs, it is important for municipalities and provinces to have the technical capacity to fulfill their obligations. On the question asked "Does your Municipality have the technical capacity to develop an AQMP on your own", the response (=19) was as follows: In only 5% of the cases, officials from municipalities were of the opinion that they had the technical capacity.

Financial resources

To meet the legal requirement to develop, implement and maintain an AQMP, adequate financial provision had to be made available. In Table VI responses indicated that international donor funding was rated the highest by municipalities (94%). The highest disagreement from municipalities was for individual specialists (80%) to provide funding.

TABLE VI: Access to financial resources

RESOURCE	MUNICIPAL	
	% Agree	% Disagree
Internal funding	63	37
Individual specialists	20	80
DEAT	88	12
Industry	69	31
International donor funding	94	6
Municipalities	-	-
Provinces	-	-

Air quality management planning

It is a legal requirement for municipalities to submit, in terms of Chapter 5 of the Municipal Systems Act, an Integrated Development Plan (IDP). All respondents from municipalities confirmed that such plan had been approved. It is also, in terms of Section 15(1) of NEM: AQA, a legal requirement to submit an AQMP as part of the IDP.

Integration of air quality management plans

The response from municipalities (n=18) indicating that at the time of the administering of the questionnaires, 28% had not included air pollution in their IDP. One of the respondents to the question did not indicate the IDP status of their Municipality.

Approval status of air quality management plans

Figure III reflects the approval status of AQMPs at

municipal level. 83% reported that they were not aware of the status of their AQMP. Only 12% reported that an approved AQMP existed and 6% reported that their AQMP was in process. Two Municipalities did not complete this section of the questionnaire.

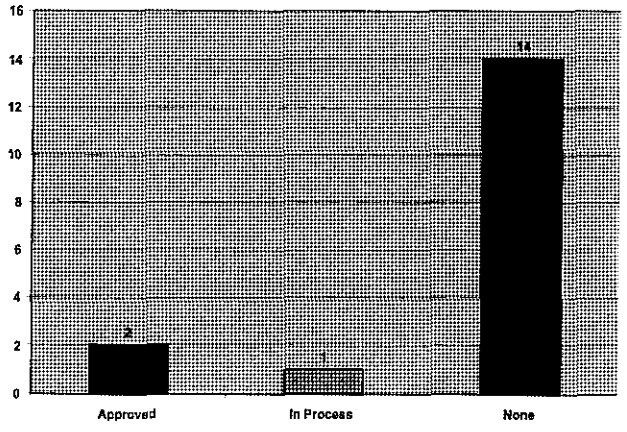

FIGURE III: Status of AQMPs – Municipalities (n=17)

Elements of an AQMP

One of the main objectives of this study was to establish a generic Framework for the contents of AQMPs. It was therefore important to establish the view of municipalities on which elements they considered necessary to include in such plans. To determine this, elements as included in AQMP's of successful countries were listed and municipalities had to indicate which of these elements they thought were prerequisites for an effective AQMP. Table VII contains the responses from municipalities on the elements suggested necessary for an effective AQMP. With the exception of two suggested elements (geographical information and setting of ambient air quality standards) on all the other elements there was 100% agreement by municipalities.

AQMP data inputs

Data inputs are necessary to populate an AQMP as well as to ensure representative outputs on which sound decisions on air quality management can be based. Once again, data inputs of effective AQMP's were listed and municipalities had to indicate which of the inputs they considered important. The results are listed in Table VIII.

TABLE VII: Elements of an AQMP

ELEMENTS	MUNICIPALITIES % Agree	% Disagree
Geographical information	95	5
Policy framework for air quality management	100	0
Air quality monitoring system	100	0
Emission quantification and reduction programme	100	0
Air quality management approval route	100	0
Air quality management review process	100	0
Capacity building process	100	0
Financial implementation cost	100	0
Setting of ambient air quality standards	89	11
Research initiatives	100	0

TABLE VIII: Data inputs for an effective AQMP

DATA INPUTS	MUNICIPALITIES % Agree	% Disagree
Source information for all air pollution types	100	0
Meteorological monitoring data	100	0
Air quality monitoring data	100	0
Demographics and land use data	100	0
Priority pollutants to be controlled	100	0
Source inventory	100	0
Air pollution reduction strategies	100	0
Evaluation of strategies	100	0
Means standards will be attained	100	0
Effect of growth and development	100	0
Contingency measures	84	16
A long term air quality management plan	95	5
Commitment to international conventions and protocols	100	0
Data on greenhouse pollutants	-	-

Strong agreement was reported on all the suggested data inputs to populate an AQMP. The lowest agreement was on contingency measures (84%) and a long-term air quality management plan (95%).

Community participation and involvement

Various environmental laws, including the NEM:AQA require compulsory community participation processes to be followed in environmental-decision making. Ninety four percent of the respondents (=17) representing municipalities highly valued community participation in developing AQMPs. Two respondents to this questionnaire did not complete this question.

Training needs

Figure III contains evidence that confidence in technical AQMP capacity was lacking amongst officers. Responses to questions on the proposed contents of training outcomes to fill the gap between existing knowledge and skills, and what would be expected from officers, are summarised in Table IX. With the exception of air pollution risk assessment (95%), on all the other suggested training outcomes there was a 100% agreement.

TABLE IX: Training needs outcomes

OUTCOMES	MUNICIPALITIES % Agree	% Disagree
Legislative framework	100	0
Air pollution and its characteristics	100	0
Engineering control	100	0
Atmospheric chemistry	100	0
Air pollution meteorology	100	0
Air pollution risk assessment	95	5
Air quality management principles	100	0
Air pollution modeling	100	0
Air pollution monitoring	100	0
Air pollution sources including identification and emission quantification	100	0
Air quality management planning	100	0
Stack monitoring	-	-
Ambient monitoring	-	-

Respondents were requested to add any training outcomes that they felt had been omitted in the questionnaire. Representatives added the following outcomes: adaptable and mitigating measures and innovations as well as community involvement principles.

RECOMMENDATIONS

Figure IV reflects the generic elements necessary for a Framework to be used to populate an AQMP. The framework elements were documented form the outcome of the questionnaire as well as the results after the framework was tested by independent specialists in the field of AQMP. For the elements of the framework to be effective it needs to be populated with data. The data necessary is listed in Figure IV as generic data inputs. For the plan to be effective and efficient it needs to be managed by competent technical officers. Generic training outcomes have been identified as input into the development of officers responsible for the development, implementation and management of AQMPs. One of the major challenges in implementing the National Environmental: Air quality act is to build capacity amongst officers at especially municipal level. The main generic benefits of implementing an air quality management plan is listed as an output of the AQMP.

CONCLUSIONS

1. Due to no response from municipalities in the Limpopo and North West provinces respectively, AQMP awareness needs to be focused on in these provinces.
2. A 89% response from environmental health practitioners is indicative that training needs have to be focused on, since environmental health practitioners are generally not air quality management specialists
3. Appointment of air quality officers is seen as a major shortcoming – only 18% had such officers
4. A dedicated AQM infrastructure is needed for effective air quality management. Only

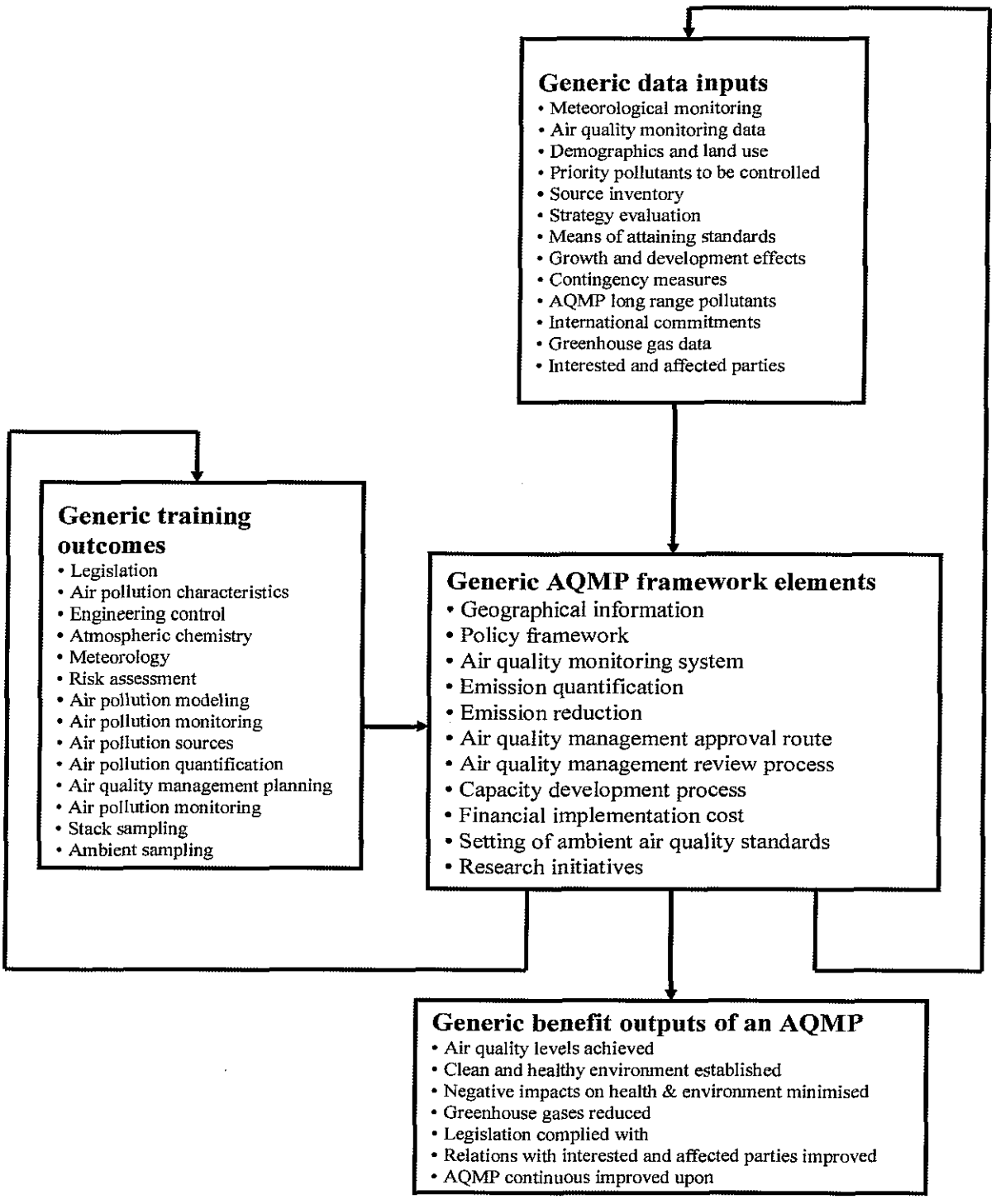

FIGURE IV: Refined generic Framework for an AQMP indicating inputs & outputs

21% of municipalities indicated that such infrastructure existed

5. Lack of technical capacity has been identified as a major shortcoming – only 5% of municipalities were confident about their technical capacity
6. Municipalities need to reorganise their budgets to include AQMP development, implementation and maintenance. Because 94% indicated that they were aware of constraints this was identified as a major shortcoming. International donor organisations and the DEAT, amongst others, have been identified as possible

sources of funding

7. Due to the fact that it is a legal requirement to have an approved AQMP, it is disturbing to note that 82% of municipalities reported that no AQM plans were even in the process of being drafted, which calls for an intensive awareness campaign amongst municipalities
8. Municipalities were very receptive to the training outcomes for municipal officers. Due to the identification of a major gap as far as technical capacity is concerned, training needs to be treated as a matter of urgency. All the training outcomes suggested were fully supported with the exception of air quality risk assessment (95%). It is suggested that government consults suitable candidates for the development and implementation of a training and awareness module, to be presented at all municipalities in South Africa.
9. The generic elements for an AQMP framework can form the basis to standardiise AQMPs submitted to Government. It can also assist to standardise the submission into the IDP of Municipalities

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