ISWA
International Solid Waste Association

abrelpe

SOLID WASTE:
guidelines for successful planning

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ABBREVIATIONS

ABRELPE – Brazilian Association of Public Cleaning and Waste Management Companies
BOO – Build Own Operate
C&D – Construction and Demolition
CBA – Cost-Benefit Analysis
CBOs – Community Based Organizations
EC – European Commission
EIA – Environmental Impact Assessment
ELV – End of Life Vehicles
ERM – Environmental Resources Management
EU – European Union
GDP – Gross Domestic Product
HCW – Healthcare Waste
ISWA – International Solid Waste Association
ISWM – Integrated Sustainable Waste Management
LCC – Life Cycle Costing
MFA – Material Flow Accounting
MIS – Management Information System
MSW – Municipal Solid Waste
NGOs – Non Governmental Organizations
PC – Personal Computer
PIs – Performance indicators
PNRS - National Policy on Solid Waste
PPPs – Public Private Partnerships
SEA – Strategic Environmental Assessment
STC – Scientific and Technical Committee
SWM – Solid Waste Management
UN – United Nations
UNEP – United Nations Environmental Program
WEEE – Waste Electrical and Electronic Equipment
WM – Waste Management
WRAP – Wellness Recovery Action Plan

PREFACE

PREFACE

A few words about this document

Good planning sets the ground for a high-quality realization and operation of waste management infrastructure and systems, which can be affordable for the societies, and with technologies that local resources can be involved.

For this reason, especially in developing countries, there is a need to include good planning practices of Solid Waste Management (SWM), to create realistic and feasible management plans and according to these, to solve the waste problem.

This document responds to this need providing a useful tool and a conclusive reference document for preparing Solid Waste Management (SWM) plans in countries being in a transitional phase. Although the good practices manual has been formulated mostly according to Brazilian requirements, its content and workability correspond to a more wide use of it. In this term, this manual will be useful to everyone involved in Solid Waste Management Planning procedures.

The project is realized and co-financed by ISWA and ABRELPE. Below, in Boxes 1 and 2, there are presented short profiles of each association. The project was selected for an ISWA grant through a competitive procedure. It will be published by ABRELPE & ISWA and will be available in ISWA's and ABRELPE's web-site, in both Portuguese and English language.

Additionally, dedicated seminars will be implemented in order to train and make familiar decision – makers, consultants and municipal employees with the particularities of SW master plans.

Box 1: ISWA's short profile

ISWA – the International Solid Waste Association – is a global, independent and non-profit making association, working in the public interest to fulfill its declared mission:

"To Promote and Develop Sustainable and Professional Waste Management Worldwide"

ISWA achieves its mission through:

- Efficiency in terms of environmental practice
- Social acceptability and efficiency in terms of economic viability
- Advancement of waste management through education and training
- Support to developing countries through ISWA Development Programme
- Professionalism through its program on professional qualifications.

One of the cornerstones of ISWA is sharing experience and information within its network of waste professionals. ISWA has amongst its members an enormous amount of expertise and knowledge on different aspects of waste management. This know-how covers technical aspects as well as social, economic and legal aspects. ISWA members and non-members can participate in this sharing of knowledge and experience through a number of different activities and products.

ISWA has its own scientific journal -Waste Management & Research, its magazine Waste Management World, the ISWA newsletter and EU newsletter.

ISWA has constructed its Technical Profile around the ISWA Technical Policies, ISWA Key Issues Papers and ISWA Position Papers.

ISWA also has produced a number of reports by or for its Working Groups or Task Forces.

For more visit ISWA's site: www.iswa.org

Box 2: ABRELPE's short profile

ABRELPE is a nonprofit association founded in 1976. To achieve its goals the association organizes conferences and training courses, studies and surveys regarding the waste sector and exchange information on a national and international basis. In addition, ABRELPE is the National Member of ISWA in Brazil.

The association has members with high technical and scientific expertise, all involved in the field of solid waste management.

ABRELPE's mission is to promote the technical and operational development of the waste management sector, always based on environmental and sustainable directives.

In its actions ABRELPE maintain strict cooperation with Public and Private entities, Universities and other organizations, developing researches, publications, capacity building events, regulation and legislative development.

Besides the institutional and relationship activities, ABRELPE also develops other relevant initiatives. In this context it is possible to highlight some important actions:

- ABRELPE Press Prize: annual prize promoted by ABRELPE to stimulate professional from the press (printed, radio and television) to publish articles regarding waste management. With this action ABRELPE promote the sector and provide wide awareness about this sector issues and solutions through the entire society.
- Panorama of Solid Waste in Brazil: published annually by Abrelpe since 2003, the "Panorama" constitutes in a document distribute to all stakeholders from the waste sector in Brazil and foreign countries, giving a complete and wide vision of the situation of waste management issues around the country through consolidated and trustful information, also conveniently treated in order to facilitate its comprehension and help to provide the necessary solutions to the existing problems. This way Abrelpe is investing in distributing qualified information as an important tool to stimulate investments in the sector and to society awareness regarding the necessary solutions.

Those activities, mainly the one related to the publication of the Panorama and its seven annual editions express Abrelpe's consolidated experience in the information research and compilation and then the publication of referential documents for the waste management sector in Brazil. All Panorama's editions and other publications are available at Abrelpe's website: www.abrelpe.org.br.

What is this Manual About?

This manual is a useful tool for everyone who wants to prepare, manage, implement, monitor and review Waste Management Plans.

The elaboration of the content presented in this manual aimed to identify and compile in an organized structure the good practices already used for successful planning and implementing integrated solid waste management systems.

More specifically this document:

- Analyzes the main issues related to Waste Management Planning,
- Mentions the general structure of a Solid Waste Management Plan,
- Identifies that main stakeholders that must be involved in the Planning Procedures,
- Provides techniques on how to understand and describe the baseline of Waste Management conditions and situations,
- Shows the required steps for successful Planning, and
- Provides techniques on how to monitor and review Planning.

For Whom?

This manual is written for anyone who phases a SWM planning challenge and more specifically for decision-makers and authorities which:

- Want to approach waste management in a sustainable way.
- Have notice that successful waste management in developing countries cannot be achieved through just copying the waste management models of the developed countries.
- Are concerned for the health and well-being of their citizens, as well as for the protection of the environment.
- Are concerned with improving waste management services.
- Are searching for a more coherent way to analyze the situation, identify the problems and encourage citizens' participation in the waste management planning process.

This tool can also be of interest to other involved parties /organizations such as:

- Representatives or staff of other local stakeholders including community;
- Local experts interested in using or replicating the results;
- Consultants working on urban services, recycling, or waste management;
- Entrepreneurs wishing to expand or strengthen their solid waste portfolios;
- NGOs, and the private sector; and
- The press, especially when seeking qualified information.

Where is this Manual Applicable?

This manual is applicable mainly to transitional countries, where the first steps towards a more structured and more organized Waste Management System are implemented. However, its general views and concepts are applicable to all Waste Management Planning procedures.

How this Manual Should be Used?

This manual should be used as a guiding tool to prepare, manage, implement, monitor and review Waste Management Plans. It provides concepts, views and specific working approaches, which when combined create a road map for successful planning. It should not be copied since it is not a Solid Waste Master Plan, but it should be used as a step by step reference guide and a conceptual directive.

In contrast, this manual aims to support local Consultants and Planners with global views and principles in order to make Planning efforts successful and more sustainable.

For that purpose, this manual is structured in a specific way that aims to provide easy navigation, useful examples and experiences, a lot of references and visual material.

Acknowledge

This Guide was prepared by ABRELPE with the support of experienced consultants. We want to thank ISWA for its grant to make real this publication and especially Mr. Antonis Mavropoulos, Chair of the Scientific and Technical Committee (STC) of ISWA, for his personal involvement and supervision of the guide as well as for providing us valuable material.

INTRODUCTION

INTRODUCTION

The purpose of this section is to define and describe the necessity for a sustainability view when a Planner drafts a Waste Management Plan. For this reason, this section analyzes views/concepts that should be used as valuable tools during the Planning procedures. The views/concepts are:

- The concept of Integrated Sustainable Waste Management (ISWM),
- A concept that visualizes barriers and drivers of Solid Waste Management (SWM), and
- The need to combine the traditional engineered and logistic approaches with social behavior analysis, for successful SWM Planning.

Why is the view so important?

It is important because planning procedures are strongly determined by the view they are designed. It is the view that influences the way the baseline, the planning procedure, as well as the final outcome are described and understood.

The following pages present some useful approaches concerning the multi dimensional view of SWM planning.

The Need for ISWM

Worldwide, there is a growing need for sustainable and coherent solutions to solid waste management problems. SWM seems to be more complex in developing countries, where the increase volume and type of wastes, as a result of economic growth, urbanization and industrialization, is becoming a burgeoning problem for national and local governments, making tougher to ensure an effective and sustainable management of waste. [1,2] Figure 1 shows why ISWM is becoming a growing need worldwide.

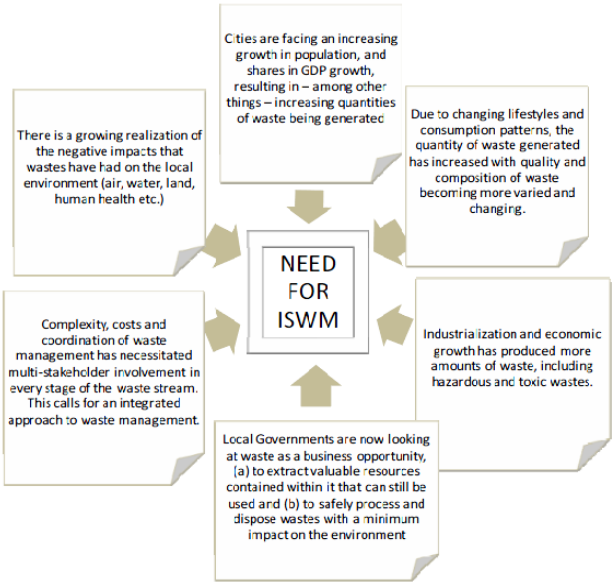

Figure 1: Need for ISWM [1]

The need to draft SWM Plans in developing countries [4]

Given the problems that inappropriate and inefficient SWM may cause, many developing countries have identified the need to draft SWM Plans. However, in many occasions this is not feasible mainly because of either lack of funds or insufficiency in institutional capacity.

In that way, many developing countries remain defenseless in front of the emerging and accumulating impacts that inappropriate SWM causes, and they continue applying practices focusing only in solving the visible part of the problem and sometimes adopt inadequate solutions like uncontrolled dumping.

Nevertheless and because of the incapability to develop SWM Plans, many authorities choose to upgrade their legislative framework by copying western legislation and trying to adopt the same technological features as those applied in developed countries, causing multiple problems.

The first problem that can arise from the adoption of a "mature" legislative framework, such as the European which took more than 40 years to evolve, is that there is left no room for phased development of these countries and usually they are discouraged from undertaking any steps at all.

Moreover, in the case that public authorities decide to implement one of the advanced technological features available they would have to find way to finance the projects since they usually are capital intensive.

Other reasons for failures of high-tech approaches, when applied without planning in transition countries, may be:

- Overestimation of the waste's calorific value;
- Simple lack of revenue to sustain sophisticated systems;
- Lack of markets to sale products;
- Unavailability or extreme cost of spare parts;
- Shortage of expertise for sophisticated maintenance [4, 10]

Box 3 provides a number of examples showing the problems caused by the import of advanced technologies in developing countries without prior appropriate planning.

Apart from the fact that all types of failures outlined above can be avoided if a SWM Plan is well drafted, the benefits that may arise from it may be multiple such as:

- Lower costs of overall waste management;
- Less environmental pollution (of soil, water and air);
- Conservation of raw materials;
- Conservation of resources, since appropriate planning does not allow inappropriate investments;
- Better coordination between urban services;
- More active citizens who contribute to urban development;
- People that are more satisfied with the service provided and thus less inclined to subversive activities;
- Built of a Better image of a city/region;
- Fewer health hazards;
- Better cost management and higher cost recovery.

- Better performance waste management departments.

Box 3: SWM failures in developing countries caused by imported advanced technologies without planning [4]

- In 1984, the Municipal Corporation of Delhi, India, built an incinerator to process 300 tonnes per day of solid waste and produce 3MW of power, with technical assistance from Denmark, at a cost of around US$3.5 million. The plant was designed for segregated waste as input, which was not practiced by the households or promoted by the municipality. The plant had to be closed down within a week of its opening as the waste had a very low heating value and a high percentage of inert materials.
- In 2003, Lucknow Municipal Corporation built an anaerobic digestion plant, as a 5MW waste-to-energy project, to process 500 to 600 tonnes of municipal waste per day at a cost of US$18 million. Private companies from Austria and Singapore provided the technical inputs, while Indian firms supplied the human resources for execution on a build–own–operate (BOO) basis. The plant was not able to operate even for a single day to its full capacity due to the high level of inert materials in the waste and was closed down. The operational difficulties and the ultimate failure were mainly due to the difference between the design assumptions that were based on European waste and waste management practices, and the actual field scenario in India.

So, why do the authorities keep on making the same mistake, namely proceeding to the installation of inappropriate units without planning?

It all has to do with capable salesmen and the "magic solutions" they can provide to their clients.

Integrated Sustainable Waste Management (ISWM)

What is ISWM?

Integrated waste management planning is a dynamic tool including aspects that range from policy-making and institutional development to technical design of integrated solutions for the handling and disposal of waste. [3]

The concept of ISWM differs a lot from the conventional approach towards waste management by seeking stakeholder participation, covering waste prevention and resource recovery, including interactions with other systems and promoting an integration of different habitat scales (city, neighborhood, household). ISWM does not cope with waste management as just a technical issue, but also recognizes the political and social factor as the most important.[3]

The Three Dimensions of ISWM

ISWM consists of three dimensions: the Stakeholders, the Waste System Elements and the Aspects of the SWM system, each of which is of crucial importance and must be taken carefully into consideration during the Planning Process (See Figure 2).

1st Dimension-Stakeholders

ISWM is, first and foremost, about participation of stakeholders. A stakeholder is a person or organization that has a stake, an interest in - in this case- waste management.

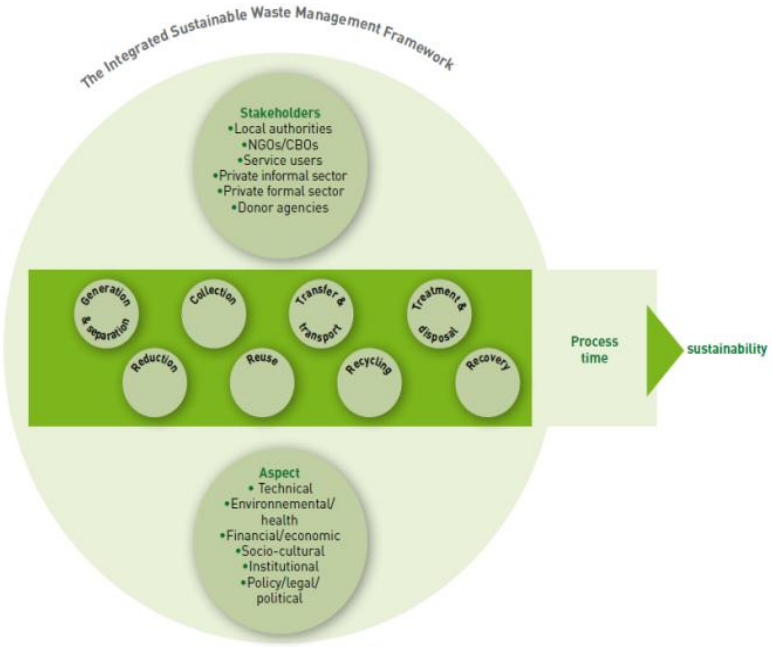

Figure 2: Integrated sustainable waste management [4]

Stakeholders by definition have different roles and interests in relation to waste management; the challenge of the ISWM process is to get them to agree to co-operate for a common purpose, that of improving the waste system.

2nd Dimension-Waste System Elements

Waste system elements refer to how solid waste is handled and where it ends up. Particularly this last point has important environmental implications and for this reason a number of national environmental ministries have taken the idea of a waste management hierarchy as an operational policy guideline. The waste management priorities, shown in Figure 3, is also a cornerstone of the ISWM approach and gives priority to waste prevention, minimization, recycling, reuse and other forms of recovery of materials

3rd Dimension – Aspects

The third dimension of ISWM refers to sustainability aspects. These aspects can be defined as principles, or lenses, through which the existing waste system can be assessed and with which a new or expanded system can be planned. [4,5]

In order the new or the expanded system to be sustainable, it needs to consider all of the technical, environmental, health, financial-economic, socio-cultural, institutional, legal and political aspects.

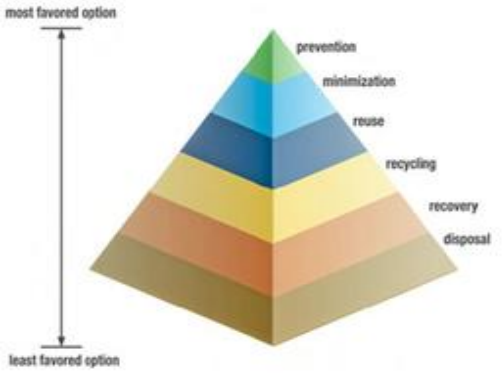

Figure 3: The SWM priorities pyramid

Hardware and Software of ISWM

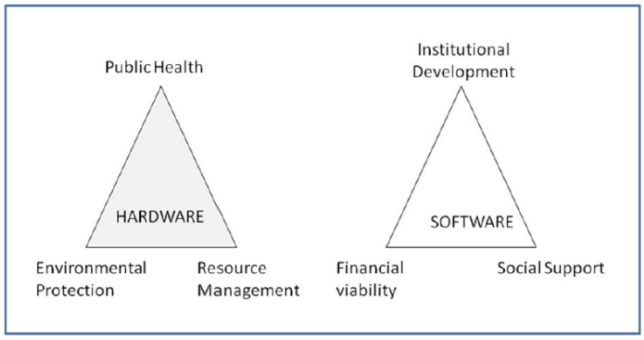

Figure 4: ISWM simplified concepts [6]

In a simplified way an ISWM system can be represented by two "triangles" (See Figure 4); the physical elements (hardware) and the governance features (software).

The first triangle compromises the three key physical elements that must be addressed for any waste management system that has to work in a sustainable way over the long term[4]:

1. Public health: maintaining healthy conditions in cities, particularly through a good waste collection service;
2. Environmental protection: throughout the waste chain, especially during treatment and disposal; and
3. Resource management: 'closing the loop' by returning both materials and nutrients to beneficial use, through preventing waste and striving for high rates of organics, recovery, reuse and recycling.

Therefore the 1st triangle is characterized as the 'Hardware' of an ISWM system.

The second triangle focuses on ISWM's 'Software': the good waste governance (strategies, policies and regulations) to deliver a well functioning system. This means that there is a need for the system to:

1. be inclusive, providing transparent spaces for stakeholders to contribute as users, providers and enablers (Social Support);
2. be financially sustainable, which means cost-effective and affordable (Financial Viability); and
3. rest on a base of sound institutions and pro-active policies (Institutional Development).

When planning an SWM system, it is of great importance to achieve a sustainable and harmonious cooperation between Hardware and Software. It is exactly like in any PC. Unless the hardware is appropriate for the software used (and vice-versa) the PC will never work efficiently.

Moreover, not all software is suitable for all hardware and not all hardware is capable to perform with certain software.

The combinatorial nature (many waste related issues and many management options) and multiple objectives of the WM problem severely constrain a sustainable waste management planning.

Not all hardware collaborates well with all software.

The above statement is usually observed when conventional technological waste management approaches are applied in emerging and transitional countries. As a result, the technologies fail to manage waste appropriately because they involve imported solutions that are centralized, bureaucratic and suitable for different socio-economic conditions. [7]

Perhaps the most important characteristic of the ISWM concept is that it demonstrates that the performance of a SWM system results from the holistic emerging behavior of the Hardware combined with the right Software. [6]

The Hardware of ISWM

Public Health (collection)

The safe removal and subsequent management of solid waste is representing one of the most vital urban environmental services.

The responsibility of municipalities to provide solid waste collection services dates back to the mid-19th century, when infectious diseases were linked, for the first time, to poor sanitation and uncollected solid waste. In order to achieve effective waste collection different approaches have been applied during the years at different places around the world. It has been noticed that not all waste collection schemes are appropriate for all situations. However, most of the development countries use the same collection system for years. In that way it is more than necessary to improve the adopted systems. [4]

Environmental Protection (waste treatment & Disposal)

Over the last decades, countries around the world have been seeking to control the growing quantities of waste and protect the environment. These two main issues have lead to build up experience on SWM and have contributed to move towards modern waste treatment and disposal practices and techniques. High-income countries have succeeded to develop modern technologies and moving from practices such uncontrolled landfilling to high performance technologies such waste incineration. However, many cities in low- and middle- income countries are still working on phasing out open dumps and establishing controlled disposal. [4]

Resource Management (valorization of recyclables and organic materials)

During the past 10-20 years, high income countries have been rediscovering the value of recycling as an integral part of their waste (and resource) management systems, and have invested heavily in both physical infrastructure and communication strategies to increase recycling rates. Their motivation is not primarily the commodity value of

the recovered materials. Probably, the principal driver is that recycling market is offering a competitive 'tank', to the increasingly expensive landfill, incineration of other treatment options. [4]

On the other hand, many developing and transitional countries have an active informal sector and micro-enterprise recycling, reuse and repair systems, which represent important initiatives towards the establishment of those activities as an economic sector to enhance the desirable rates. [4]

The Software of ISWM

Social Support

A certain way to failure is develop a waste management plan with limited or even no interaction with the involved stakeholders. In contrast, the best-functioning SWM systems should involve all the stakeholders in planning, implementing, and monitoring the changes. In this sense it is crucial the relevant authority/body to demonstrate a range of good practices in issues such as: [4]

- Consultation, communication & involvement of users;
- Participatory & inclusive planning
- Inclusivity in siting facilities; and
- Institutionalizing inclusivity - the solid waste 'platform'

Financial Viability

Financial Viability in SWM is a major issue for all cities around the world. In developing and transitional countries, SWM represents a significant proportion of the total recurrent budget of the city, with figures ranging from 3 to 15%. [4]

In high-income countries cost of SWM are continuing to increase as SWM is moving to more expensive waste management practices and disposal technologies. The costs are further increasing by the adoption of more strictly environmental protection measures.

In the coming years, low- and middle-income countries will also experience an increase in the costs of SWM. This mainly relies on the fact that, in these countries, waste quantities are going to increase significantly, and more staff, equipment and facilities will be required to adequately manage them.

It is urgent that responsible authorities find ways to recover SWM costs in order to keep its economical sustainability and quality.

Institutional Development

A strong and transparent institutional framework is essential to good governance in SWM. Without such a framework, the system will not function well over the long term. In addition, if waste services are designed to be effective, a city must have the capacity and the organizational structure to manage finances and services in an efficient and transparent manner, streamline management responsibilities with its communities, and listen to the system's users. The waste management system to work well, the city needs to address underlying issues relating to management structures, contracting procedures, labor practices accounting, cost recovery and corruption. Clear budgets and lines of accountability are essential. [4]

SWM as the Result of Interactions

Solid Waste Management is a result of interactions. Imprint to a graph of the forces that affect a solid waste management system can be a really useful way for everyone to understand how these forces interact and how great and direct are their impacts to the system, regarding always its sustainability. [8]

More specifically, the forces that increase the sustainability of the SWM system are called drivers, whereas the forces that decrease its sustainability are called barriers. A more comprehensive imprint of the drivers and of the barriers of a SWM system is achieved with the use of vectors, a method that makes easier obvious which forces are drivers and which are barriers. Such "forces" may be specific stakeholders (NGO's, agencies, waste management enterprises etc.), policies and legislative tool, lifecycle issues, and whatever else issue that may be considered essential for the planning process. The longer is a vector, the bigger is its impact on the waste management system. The more vertical is a vector, the more direct is its impact on the waste management system. Despite not being appropriate for quantitative results, this technique provides a very good qualitative view.

An example of this technique is presented in figure 5, which imprints the drivers and the barriers that interact in most current SWM systems. The first portrait indicates the drivers (blue vectors) and the barriers (red vectors), whereas the second portrait imprints the overall result (purple vector) of these forces to the sustainability of the system. By observing the second portrait it can be seen that the forces interacting in the most SWM systems tend to decrease their sustainability. For this reason, it is required intervention for the addition of drivers (third portrait), such as appropriate planning, massive collaboration and development of the SWM industry (yellow and green dashed lines), to change the overall result of the forces interacting to the system and lead it to sustainable paths (white dashed line).

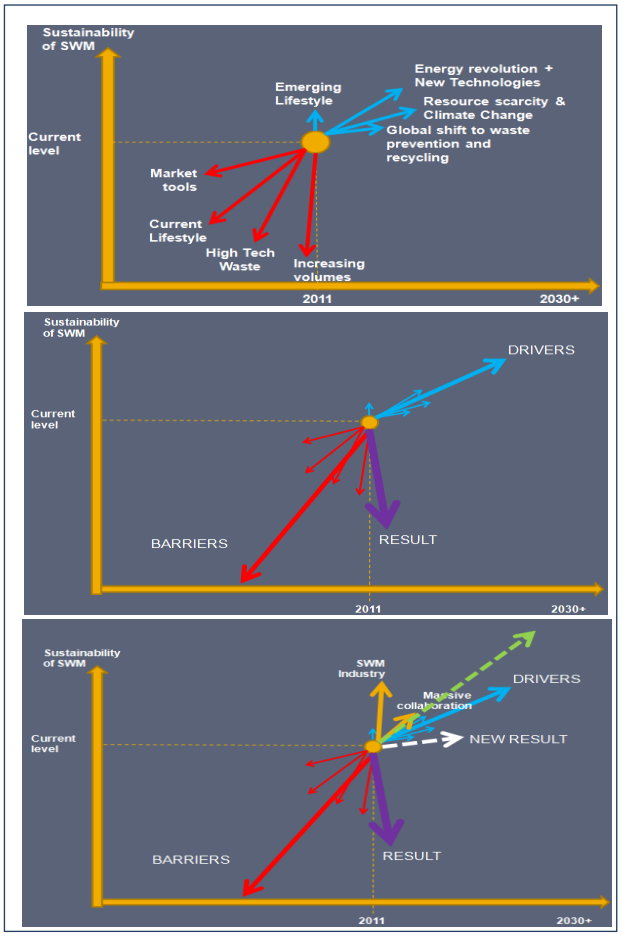

Figure 5: The role of forces in the SWM system [8]

Beyond Engineering & Logistics

When the current modernization process started in developed countries during the 1970s, SWM was seen largely as a technical problem with engineering solutions. That changed during the 1980s and 1990s when it became clear that municipalities could not successfully collect and remove waste without active cooperation from the service users. Cities also learned that technologies depend on institutional, governance and policy frameworks, which are highly varied and complex and directly related to local conditions.

Nowadays, it is obvious that the overall performance of a SWM system results from continuous interactions local markets, emerging social behavior, city governance, local stakeholders, city growth etc. And those interactions are hardly described by the traditional waste management approaches which are based on engineering and logistics. Furthermore, most current SWM plans focus on improving the effectiveness of community recycling and outreach programs.

The problem might be more general [6]. As long as we face SWM as a matter of appropriate storage, collection, transfer, treatment and disposal and the main effort was to minimize environmental and health impacts, engineering and logistic tools were sufficient to plan and implement waste management systems. However in our days, resource management and social behavior are becoming an organic part of any SWM system and they are essential to address increasing recycling rates and better quality of recyclables, participation of industrial stakeholders, eco-design initiatives and closed loops of products and materials.

Consequently, engineering and logistic tools are not enough to plan and deliver SWM systems. A SWM system is considered as a “complex system”, meaning that a system composed of interconnected parts, which exhibit as a whole one or more property of the system (behavior among the possible properties), which are not obvious when the properties are exhibited as individual parts. [9]

References

The authors encourage all readers to visit ISWA's knowledge base (http://www.iswa.org/en/525/knowledge_base.html), which contains more than a thousand articles, presentations and technical studies, many of which were used as sources for the realization of this document. Indicatively, they are proposed for studying the following:

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OVERVIEW OF SWM PLANNING

This section introduces the reader to the SWM Planning Procedures. Its first part outlines the scope of a SWM Plan and describes briefly the steps taking place during the Planning Process. The second part refers to the issues that should be dealt before moving to the drafting of the Plan, so as to save time and avoid troubles.

Prepare SWM Plans

SWM Plans

Despite the fact that several SWM Plans have been developed around the world, there is no certain pattern on how to construct them. This probably is one of the main reasons why SWM Plans, in many cases, highlight only the problems of SWM but are incapable to handle the total waste management problem in an integrated way and fail to provide sustainable solutions.[1] Another factor contributing to the above may be considered the fact that not all SWM models are appropriate for all places. As a consequence, SWM systems that have been applied successfully in developed countries, may have no use in developing ones, or might be successful only under certain conditions. The latter probably is the main reason why waste management in developing countries needs the sustainable view that is described in the previous section of this document.

Overview of SWM Plans

SWM plans have a key role to play in achieving sustainable waste management. More specifically a SWM plan aims to:

- *Define the baseline:* Collecting reliable data and other information on the existing waste situation, for national, provincial or local government, or for a specific industry, is a critical first step in compiling an integrated waste management plan. The aim of gathering this background information is to provide a realistic and quantitative basis for the development of the plan, based on actual data and prioritized requirements and needs. [2]
- *Identify the roles & responsibilities of key stakeholders:* When preparing an ISWM plan attention shall be placed on ensuring that the roles and responsibilities of key stakeholders are clearly defined.
- *Identify the strong & weak points of the current SWM system:* It is important to identify the true character of the current SWM system and establish a basis of its shortfalls, constraints and/or strong points.
  Problems may be characterized as either:
  Internal to the SWM system such as lack of equipment or planning capacity, etc);
  Both internal & external like accelerated waste generation, lack of co-ordination etc., which will generally require close cooperation with related sectors; and
  External problems such as uncontrolled urbanization, population explosions etc. will generally have to be accepted and adapted. [3]
- *Prepare the appropriate SWM action plans:* It is the core of the planning procedures as it defines the actions to be implemented and which will establish the new SWM system. The difficultly of this activity is to comprehend the meaning of what is an "appropriate" SWM action plan.
- *Provide guidelines on how to pass from the planning phase to the implementation phase:*
  It is crucial to ensure the continuity between the planning process itself and the implementation. Therefore the planning process should provide detailed guidance on performance measures and information management systems, both of which should be used to monitor the performance of SWM systems and thus the implementation of the SWM Plan.
- *Control of technological measures:* An outline of waste ensures identification of areas in which technological measures should be taken to eliminate or minimize certain types of waste. [3]
- *Outline of governance requirements:* SWM plans make way for statement of financial, institutional and social requirements. On this basis, the need for future actions, such as investments in SWM plans, public awareness campaigns, training courses for the relevant authorities and etc., may be determined.

The Planning Process

The planning process of a SWM system may be broken down in *five* major phases.

The Mobilizing Phase: It is the phase prior the beginning of the planning process. In the initial phase of the SWM planning it is substantial to implement activities that will mobilize the planning process. These activities are mainly related to 'Mobilizing Support' activities, which include the 'Political Support' and the 'Stakeholders' Participation. In that way it is ensured engagement and cooperation of the main stakeholders, factors that will "push" forward the procedure to proper implementation.

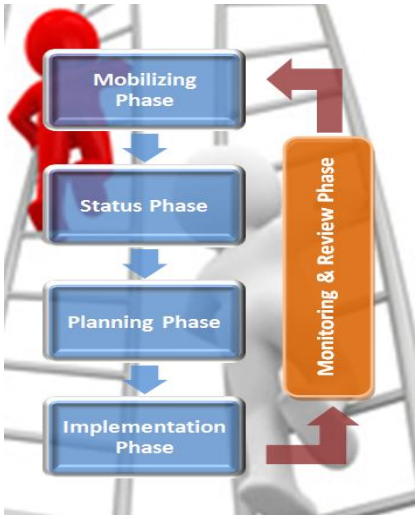

Figure 6: The Planning Process

The Status Phase: It is the phase that a comprehensive baseline of the current situation in SWM is created. Aim of the baseline is to evaluate the range of institutional, technical and promotional aspects of current SWM and define key shortfalls and constrains. This valuable management of information forms a benchmark for the design of an improved SWM system.

The Planning Phase: It involves all the activities required to prepare an appropriate SWM action plan. The planning part is prepared in accordance to the baseline, the requirements set by the national legislation and the relevant assumptions for projecting future developments.

The Implementation Phase: After the development of the SWM plan, its assumptions are put into practice via the appropriate legislative, technological and logistic systems. An implementation program is prepared.

The Monitoring & Review Phase: A main question in the planning process is if the present or planned waste management system is the most efficient means to reach the objectives set. For such an assessment, the goals of waste management have to be brought to an assessable level, and criteria have to be defined to allow an evaluation of the waste management system on a quantifiable basis. Therefore the monitoring

and review phase involves activities which identify the actions that shall be monitored and the relevant indicators of performance. Indicators are then estimated and the applied SWM system is evaluated and reviewed. Wherever deficiencies and low performance are observed additional action to improve the applied SWM system are implemented.

According to the structure of this document:

- **Issues about the Status Phase can be found on the Chapter Status Part of this Guide, and**
- **Issues about the Planning, the Implementation and the Monitoring and Review Phases can be found on the Chapter Planning Part of this Guide.**

General Structure of a SWM Plan

Although each country creates its own patterns about what is the structure of a waste management Master Plan, there is not a generally recognized structure. This is because the detailed structure of a waste management master plan depends a lot on its specific purpose and area, the time horizon as well as the local legislation needs. However, from the experiences gained in different conditions and parts of the world, a generic approach can be concluded. Such approach is presented in Box 4.

Box 4: Elements in a Waste Management Plan

Background
- Overall waste problematic
- Legislation
- Description of national waste policy and prevailing principles
- Description of objectives set up in specific areas
- Inputs from the consultation process

Status Part
- Diagnosis of Current Waste Management
  - *Waste sources & streams*
  - *Amounts of wastes & types*
  - *Existing waste management system*
  - *Economics & financing of the WM system*
- Projections
  - *Socio-economic projections*
  - *Waste projections*
- Conclusions
  - Strong and weak points

Planning Part
- Assumptions for planning
- Definition of the scope of the plan
- Proposal of scenarios
- Setting goals & targets
- Action Plan

Implementation Part
- Establish instruments for the implementation of a waste management plan
  - *Policy instruments*
  - *Legal instruments*
  - *Economic instruments*
  - *Environmental agreements / partnerships*
  - *Public awareness & communication*
  - *Planning*
- **Implementation program**

Box 4: Elements in a Waste Management Plan (ctd)

Monitoring & Review
- Define the actions to be monitored
- Define the means and right indicators to measure the performance of the applied SWM system
- Assess & review the applied SWM system

Issues of Concern

Before moving to the implementation of a SWM Master Plan, there are certain issues that should be taken into consideration. Purpose of this subsection is to provide a clear view of these issues to the reader, helping him to understand in depth the concept of the Planning Process, an indispensable element for the successful drafting and implementation of a SWM Master Plan.

The issues that are analyzed in this subsection are:

- The Scope of the Master Plan
- Time Horizon of the Plan
- Stakeholders in the Planning process
- The role of informal sector
- Public awareness and communication
- Identification and Prioritization of needs
- Environmental Impact of a Master Plan
- Time schedule of a Master Plan
- Relationship with other Plans

The Scope of a Master Plan

A Master Plan, in order to be effective, it should provide answers to three key issues:

1. What are the types and amounts of waste in the studied geographical areas;
2. What are the priorities and needs of the current SWM system;
3. Which are the specific objectives of the SWM Plan, as they are provided either by legislation or by specific local priorities and conditions.

Time Horizon of the Plan

Another important element of the Solid Waste Management Plan is the time horizon for which it is designed. There are several factors affecting the time horizon of a plan, one of which is the coverage area. More specifically, a national Master Plan should be designed for long term implementation, so as to guaranty a logical time interval to assess the implemented measures, whereas Plans for smaller geographical areas should be more “flexible” and to correspond to the immediate needs of the waste management system. In addition, another factor that affects the time horizon of a Master Plan is the measures that it proposes for implementation, since there are measures requiring immediate implementation, whereas others would be designed for long term implementation, responding to the evolution of the waste management system’s characteristics. However, independently the time horizon of a Master Plan, it is suggested to be revised in regular intervals, usually around 3-5 years.

Stakeholders in the Planning process

Stakeholder is defined as a person, a group, an institution or an organization that has a stake in an activity or project. The stakeholder may be directly or indirectly affected by the project or to have the ability to influence it either positively or negatively.[4,5,6]

The stakeholders in a Waste Management Planning Process can play a very important role influencing significantly the whole procedure, thus their early identification and integration in the Planning Process is indispensable.

The identification of stakeholder is of great importance and it is highlighted because of the fact that there is no certain pattern to define them. What is more, they differ from place to place. So, they need to be identified in the local context and often also grouped according to their interests and to get them to agree to co-operate for a common purpose, that of improving the waste management system. [5]

Despite the fact that many stakeholders have different interests (economic, political influence, social status, etc.) and play different roles, they can cooperate for a common interest and form "alliances". [7,8] This type of "alliances" among different actors in waste management can be defined as 'established relationships between two or more different actors, having as objective to reap off a mutual benefit through waste management activities' (without assuming equality in the bargaining power, because the influence and the importance of the actors may vary). [9,10,11]

Having identified the relevant stakeholders, it is very important to mobilize them to participate into the Planning process, not only by saying their opinion or to complain when some of their privileges are affected, but by calling them to play an active role through collecting and providing data when necessary, give input to decisions but more specifically to act as a self correcting mechanism and to warn the rest participants of the Planning Process in case that a particular interest group tries to ruin or to take advantage of the procedures.[12] In addition, the responsibilities of each stakeholder must be clear and well defined, in order to avoid the duplication of work.

The involvement of the various stakeholders in the planning process aims at ensuring at least acceptance and at best active support of the waste policy in general and contribution to the attainment of its objectives.[13]

The Role of Informal Sector

In many cities around the world, and especially in the rapidly developing ones, considerable number of people sustain themselves and their families by reclaiming reusable and recyclable materials from what others have cast aside as waste. [14,15]

There are many different terms to refer to them, some of which are scavenger (which is seen as derogatory and has been rejected by many who do this work), rag picker, reclaimer, recycler, salvager, waste picker, waste collector and others, usually depending on the type of material they collect. [15]

Informal sector poses a major policy dilemma for city governments. The presence of large communities of people making a living from waste, often in appalling sanitary conditions, can be an embarrassment to politicians in a rapidly commercializing city. In some cities of the world and especially in rich cities of Asia, the work of itinerant waste buyers is being restricted, sometimes to the point of being illegal, in a try to avoid visual disturbance and sanitary threat.[16] In other occasions, informal sector is usually ignored or treated as invisible. However, recent reports mention that informal sector has started to organize not only in local but in global level too. The formation of groups or councils that protect the rights of informal sector is a fact and it keeps growing, especially in Latin America and Asia. In that way, it is both shown its considerable size – World Bank estimates that 1% of the world's population, or 50 million people [15] , earn their livelihood from these activities – and that areas with "strong" and competitive informal sector, should not ignore it when planning procedures take place, but they should integrate it in the planning process in order to achieve sustainable results. In addition, it should be always kept in mind that a major challenge of waste management in developing countries is how best to work with the existing informal recycling sector to improve livelihoods, working conditions and recycling efficiency. [14, 15]

Public Awareness & Communication

Public awareness and communication appear to be critical points when drafting a SWM Master Plan and this because Planning must have the consent of the public, since public is going to implement the Plan and determine in great extent its success or its failure. For this reason, it is important authorities to inform public for the procedures taking place, having additionally a first view on its reactions, but preparing also simultaneously the implementation of the Plan. What is more, in that way it is guaranteed the transparency of the procedures and they are minimized the reactions after the completion of the Master Plan.

Environmental Impacts of a SW Master Plan

Given the fact that a Waste Management Master Plan is developed to protect public health and environment from the hazards that inefficient or non existing waste management can cause, it is very important to identify the environmental effects of the implementation of a Master Plan.

Usually, the environmental effects of the implementation of a SWM Master Plan are positive as the initial scope of a SWM Plan is to upgrade the current waste management system. On the other hand the maintenance of the current situation (baseline) and the absence of effective SWM planning may lead to adverse effects.

The consequences associated with non-sustainable SWM are difficult to be quantified. However, environmental impacts may be identified by a number of indicators such as changes in: recycling rates, values of specific pollutants, fees, diversion rates etc.

Time Schedule of a Master Plan

The time schedule of a Plan outlines the duration of different stages and provides the time by which the Plan should have been completed. The time schedule should take seriously into consideration all Planning steps and especially the consultation period with the public, which is considered time-consuming.

The time for the completion of a Waste Management Plan may vary according to its urgency, the availability of the information required and the depth of design. More specifically, if it is demanded only strategic planning, it may last 3 months; however, if they are required sitings or other planning procedures, the entire Planning process is expected to last more, up to 18 or even 24 months.

Relationship with other Plans

In our days, that waste amounts keep increasing and waste management is becoming more and more complex, the need for Waste Management Plans is vital. However, in order their implementation to be successful, they should be in compliance with the rest national Plans and not to

Source:
http://postconflict.unep.ch/sudanreport/sudan_website/index_photos_2.php?key=waste%20treatment

contradict. The Plans that may be directly related to Waste Management Plans are:

- Environmental Plans,
- Energy Plans,
- Health Plans,
- Spatial Plans,
- Sanitation Plan.

References

The authors encourage all readers to visit ISWA's knowledge base (http://www.iswa.org/en/525/knowledge_base.html), which contains more than a thousand articles, presentations and technical studies, many of which were used as sources for the realization of this document. Indicatively, they are proposed for studying the following:

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GLOBAL POLICY TRENDS IN SWM

SWM Policy Trends in EU

The European Waste Policy Framework

Around 2 billion tonnes of waste are generated in the EU each year, and the amounts of waste are rising steadily. On this respect a number of Directives have been embodied in the European waste policy (See Figure 7), setting specific goals and targets to limit the generation of waste and to optimize the organization of waste treatment and disposal among EU Member States.

Waste Directive 2008/98/EC is the main legislative instrument defining the EU waste principles and introducing basic policy instruments to implement these principles.

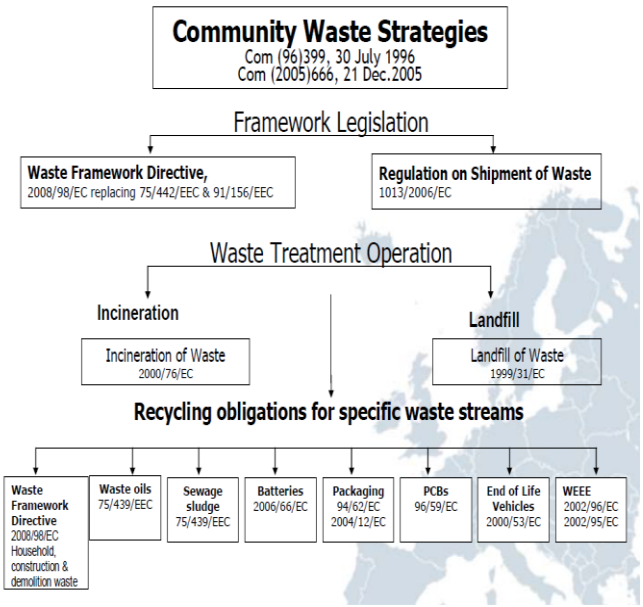

Figure 7: European Waste Management Legislation [1]

The Waste Framework Directive

All Member States of the EU and of the European Economic Area (Iceland, Liechtenstein and Norway) are bound by the principles and targets introduced by the Waste Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008.

Directive 2008/98/EC sets the basic concepts and definitions related to waste management, such as definitions of waste, recycling, recovery. It explains when waste ceases to be waste and becomes a secondary raw material (so called end-of-waste criteria), and how to distinguish between waste and by-products. This Directive establishes a legal framework for the treatment of waste within the Community. It aims at protecting the environment and human health through the prevention of the harmful effects of waste generation and waste management.

In addition, waste legislation and policy of the EU Member States shall apply as a priority order the following waste management hierarchy:

Figure 8: Waste management hierarchy in EU Legislation [2]

The Directive introduces the "polluter pays principle" and the "extended producer responsibility". It incorporates provisions on hazardous waste and waste oils, and includes two new recycling and recovery targets to be achieved by 2020: 50% preparing for re-use and recycling of certain waste materials from households and other origins similar to households, and 70% preparing for re-use, recycling and other recovery of construction and demolition waste. The Directive requires that Member States adopt waste management plans and waste prevention programs.

EU Waste Principles

European Union's approach to waste management is based on the following basic principles [3] :

Waste prevention: This is a key factor of the so called waste hierarchy. Reducing the amount of waste generated at source and reducing the hazardous content of that waste automatically simplifies its disposal. Waste prevention is closely linked with improving manufacturing methods and influencing consumers to demand greener products and less packaging.

Recycling & reuse: If waste cannot be prevented, as many of the materials as possible should be recovered, preferably by recycling. The European Commission has defined several specific 'waste streams' for priority attention, the aim being to reduce their overall environmental impact. This includes packaging waste, end-of-life vehicles, batteries, electrical and electronic waste. EU directives now require Member States to introduce legislation on waste collection, reuse, recycling and disposal of these waste streams. Several EU countries are already managing to recycle over 50% of packaging waste.

Waste Diversion From Landfill: Diverting waste from landfill is an important element in EU policy on improving the use of resources and reducing the environmental impacts of waste management. In particular, in pursuance of Directive 1999/31/EC on landfill of waste Member States are obliged to set up national strategies for reducing the amount of biodegradable municipal waste going to landfill.

Several new provisions have been introduced in the waste directive 2008/98/EC to reduce landfilling, as well. Key issues are the introduction of quantitative targets on recycling of selected waste materials from households and other origins, and of construction and demolition waste. In addition it bans certain types of waste, such as used tires.

Where possible, waste that cannot be recycled or reused should be safely incinerated, with landfill only used as a last resort. Both these methods need close monitoring because of their potential for causing severe environmental damage.

Green House Gases Reduction

The Union also wants to reduce emissions of dioxins and acid gases such as nitrogen oxides (NOx), sulphur dioxides (SO_2), and hydrogen chlorides (HCL), which can be harmful to human health.

Life-cycle thinking is a new element of the EU's new waste policy which includes evaluations of the impacts of waste and the use of natural resources on the environment and human health. According to this approach waste policies must contribute to eco-efficiency and the sustainable use of resources. However, the traditional waste hierarchy will also remain a guiding principle behind waste management. [4]

> One man's waste can easily become another man's valuable material, or a useful energy source.

Basic Key (Policy) Instruments

In order to achieve the above principles the following instruments have been developed and are of major utilization among EU Member States:

- Minimum Recycling Standards & Introduce recycling schemes
- Waste taxes
- Bans on landfilling /incinerating specific waste types
- Extended Producer Responsibility
- Pay-by-Use

SWM Policy Trends in Japan

Japanese Waste Management legislation through time

Undoubtedly, Japan is one of the leading countries globally concerning waste management technologies and practices. Japan understood from very early that proper waste management is efficient and successful only when it is supported by the appropriate legislative framework. This fact led Japan to become a pioneer not only in Asia but in global level too. As a result, the first legislative task was conducted in 1954, with the establishment of the Public Cleansing Law, which aimed to protect and improve public health by sanitarily disposing of waste and cleaning the living environment. However, the rapid economic growth of the Japanese economy led to many changes in the people's lives and in the amounts and the types of the wastes produced. These changes made obvious the need for a change in the legislative framework of the country, since the Public Cleansing Law was not enough by itself to deal with the keep growing waste amounts and types. This fact led in 1970 to the abolishment of the aforementioned Law and to the establishment of the Waste Management Law (nowadays called the Waste Management and Cleansing Law), comprising the first step toward the establishment of today's waste management system.

Today the Legislative framework of waste management in Japan is based on the Waste Management and Cleansing Law who is regularly revised since 1970, the 'Law for Promotion of Effective Utilization of Resources'- enforced in 1991 the Law of Material-Cycle Fundamental Law –enforced in 2000 and a number of other laws, concerning specific waste streams - enforced since the 1990s.

Figure 9 provides a basic understanding of the waste framework in Japan today.

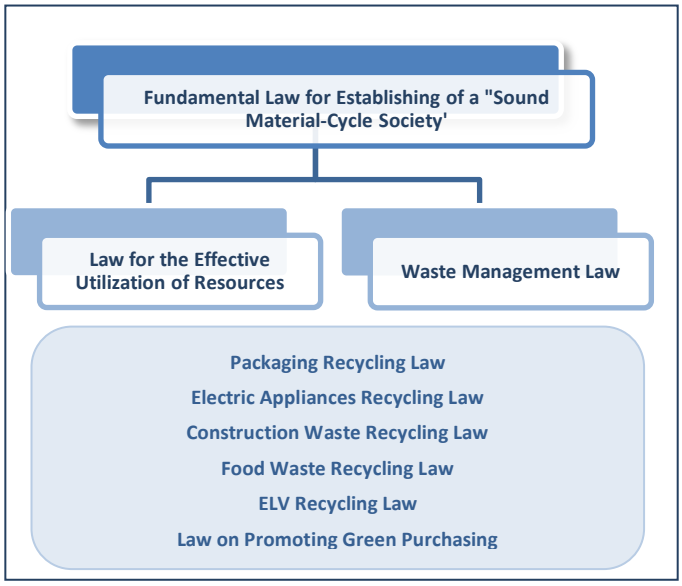

Figure 9: Basic waste legislative framework in Japan

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SWM
IN BRAZIL

SWM Background in Brazil

SWM Background [1]

The structure of the SWM background has been done according to the issue that is analyzed in each subsection. The issues analyzed are divided in Municipal Solid Waste (MSW), Urban Cleaning, Separate Collection and Recycling, and Other Streams.

Municipal Solid Waste (MSW)

MSW is the basic stream of wastes for all the countries around the globe.

Figure 10 provides information concerning the overall and the per capita MSW generation. It can be seen that there is an expressive trend in MSW generation, but not as great as it was last year. Figure 11 provides data related to the overall and the per capita collection of MSW in Brazil, showing again an expressive trend, leaving however more than 6 million tonnes of waste uncollected.

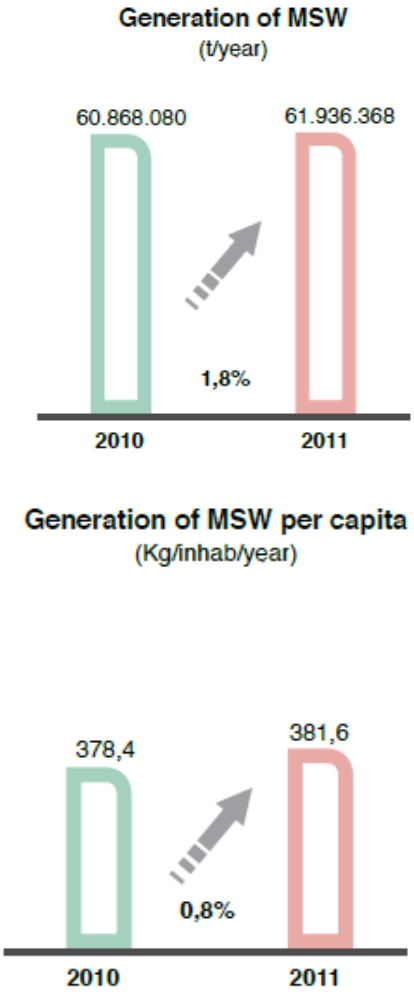


Figure 10: Overall MSW generation and MSW generation per capita in Brazil, for years 2009 and 2010

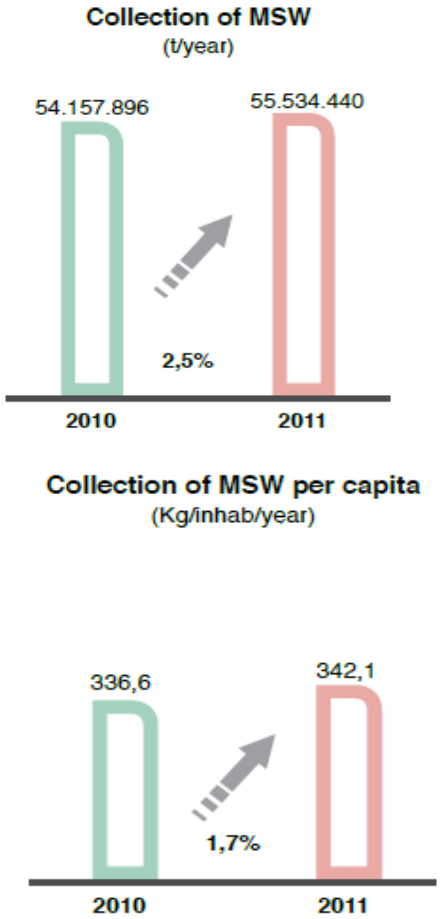


Figure 11: Collection of overall MSW and of MSW per capita in Brazil, for years 2009 and 2010

The information provided from figures 10 and 11 is of great importance since it is highlighted with the best way the need for immediate action. This arises from the following facts:

- The MSW generation and collection rates per inhabitant surpass the population growth rate of the country – which for this period was approximately 1% – (registered by IBGE).
- There is an important possibility of improvement of collection services – which should not be ignored – so as to collect a great part of MSW that in 2011 remained uncollected and which is about 6.5 million tonnes.

Separate Collection and Recycling

Separate collection and recycling are basic and indispensable elements of every modern SWM system, not only for environmental reasons but for financial also.

In 2011, of the 5.565 municipalities of Brazil, 3.263 indicated the existence of separate collection. Table 1 following shows the percentages of municipalities per region and in Brazil that have applied separate collection.

Table 1: Amount and Percentages of Municipalities per region and in Brazil with Separate Collection Initiatives in 2010

	Total number of Municipalities	Municipalities with Separate Collection Initiatives in 2011	Percentage (%) of Municipalities with Separate Collection Initiatives in 2010
Brazil	5565	3263	58,6%
North	449	209	46,5%
Northeast	1794	651	36,3%
Midwest	466	131	28,1%
Southeast	1668	1336	80,1%
South	1188	936	78,8%

From the data provided in table 1, it is obvious that Southeast and South regions contribute in greater extent in recycling than the other regions. In that way, it can be set as a first target, the increase of recycling programs in the rest areas of the Brazilian territory.

However, it should be mentioned that the Brazilian market seem to present a great dynamic for separate collection system and this is strongly argued by the recycling rates that have been achieved for specific materials such as aluminum, paper and glass, whose recycling rates for 2009 were 38%, 46% and 47% respectively. In addition, the recycling rate for PET for the same year was 56%.

Other Streams

This subsection aims to provide information for two other waste streams that are collected by the Municipal authorities in Brazil. These streams are Construction and Demolition Waste (C&D) and Healthcare Waste (HCW).

Construction & Demolition (C&D) Waste

Figure 12 following provide information concerning the amount of C&D waste that was collected in 2010 and in 2011 by Brazilian Municipal Authorities. By observing the figure, it can be seen that there is an expressive trend in the collected amount of the C&D Waste in all the country's regions. From one point of view, this may be seen as beneficial since C&D are not disposed of by their producers to illegal dumpsites, however now, it is the municipalities that have to seek for proper final destination of the waste.

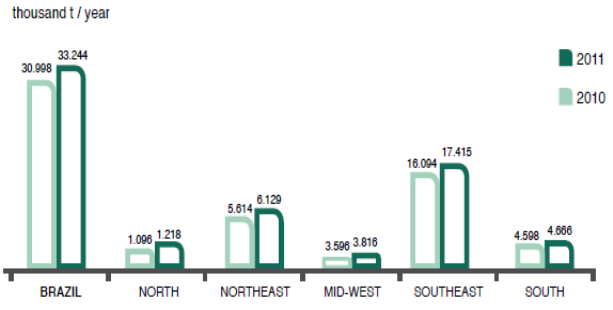
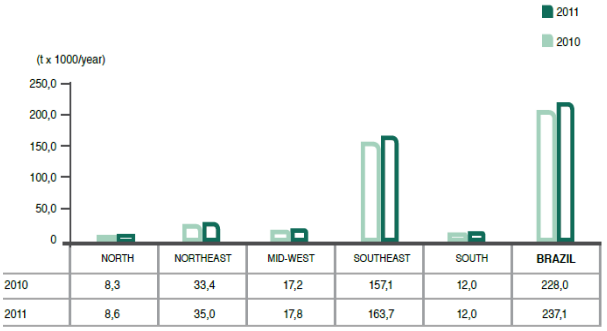


Figure 12: Total C&D Waste collected per region and in Brazil

Health Care Waste (HCW)

HCW wastes are considered hazardous and require specific ways of collection and treatment prior to their disposal. Given the fact that federal resolutions assign the responsibility of HCW to the generators, all the municipalities with public healthcare units are responsible for the collection, treatment and final disposal of the wastes they produce.

Figure 13 following presents the amounts of HCW collected by Municipalities per region and in Brazil for years 2010 and 2011. By observing the figure, it can be seen a small growth in the collected amounts of HCW.



	NORTH	NORTHEAST	MID-WEST	SOUTHEAST	SOUTH	BRAZIL
2010	8,3	33,4	17,2	157,1	12,0	228,0
2011	8,6	35,0	17,8	163,7	12,0	237,1

Figure 13: Amounts of HCW collected per region and in Brazil

Finally, Figure 14 provides a view about how Municipalities disposed the HCW they collected. It is observed that despite the hazardous load of HCW, 12,5% of the total amount collected still goes to open dumps.

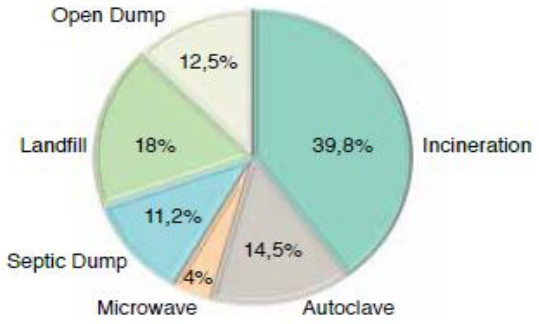


Figure 14: Final Disposal of HCW Collected by the Municipalities in 2010

SWM Policy in Brazil [2, 3, 4, 5, 6]

The Brazilian Law for Solid Waste

On August 2nd, 2010, the President signed the National Policy on Solid Waste (PNRS) after two decades of debate in the Brazilian Congress. With this decision, Brazilian legislative framework for Solid Waste becomes equal to the European corresponding.

More specifically, Law 12305 provides principles, objectives, instruments, and guidelines for integrated SWM in Brazil, including hazardous waste, the responsibilities of generators and the public power and the applicable economic instruments.

The new Brazilian legislative framework is in line with the global state of the art SWM practices, aiming amongst other actions to:

- protect public health,
- achieve integrated and environmental sound waste management,
- sustain environmental quality,
- adopt, develop and improve clean technologies, so as to minimize environmental impacts, and

- reduce the volume of hazardous waste.

Figure 15 following presents the waste management priorities according to the Brazilian legislation. As it can be seen, non generation and waste minimization are identified as priorities, prohibiting the same time waste disposal, unless all non-disposal alternatives have been exhausted.

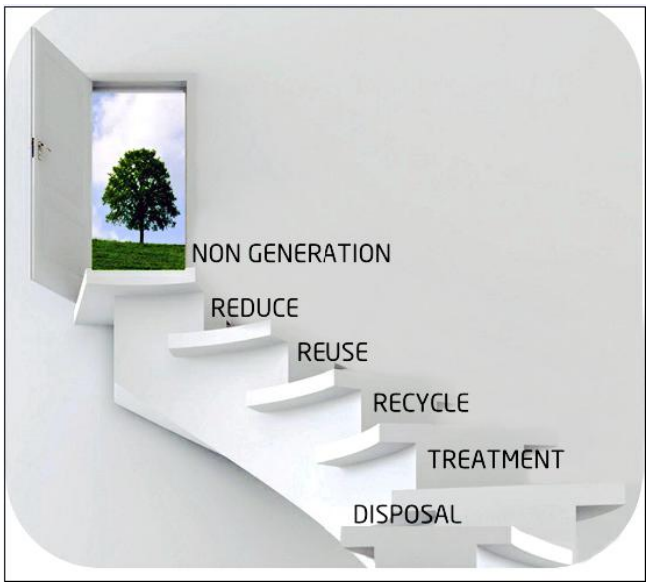


Figure 15: Waste management priorities in the Brazilian Law

The National Law for Solid Waste defines three basic areas to be addressed: i) the preparation of Solid Waste Plans, ii) the principle of shared responsibility for the life cycle of products among government, companies and the public iii) the participation of the scavengers of recyclable and reusable materials in the SWM system. The paragraphs following are analyzing each of these "areas".

Preparation of Solid Waste Plans

Brazilian legislation declares the need for implementation of Solid Waste in all levels. The categorization of the Solid Waste Plans is done according to the area they cover or the project/object they concern.

The principle of shared responsibility for the life cycle of products among public authorities, companies and the public

As its title outlines, the shared responsibility for the life cycle of products is not an issue that concerns only one stakeholder engaged in SWM, but it is an issue requiring separate approach for all the engaged stakeholders.

Public authorities

The National Law for solid waste defines municipal authorities as the main responsible to manage urban cleaning and the collection and final disposal of garbage. In addition, municipal authorities have to establish selective collection of recyclables and composting systems for organic waste. In that way, they achieve both environmental and economic benefits, since they preserve natural resources, take advantage of the value of the materials recycled and sustain their landfills, since the amounts of waste reaching them are reduced significantly.

The public

The public from each side, namely the users of the SW services, in case of establishment of a selective collection system, are required to participate in it, providing for collection the reusable and recyclable solid waste, properly packaged and in a sorted way.

Companies

The principle of shared responsibility for the life cycle of products **is related to the companies with the concept reverse logistics. Reverse logistics** is regarded as a milestone of the Brazilian Solid Waste policy, according to which when a product reaches at the end of its useful life, it is returned to its manufacturer or importer for recycling or other appropriate treatment. A means used to achieve this target is the imposing from the authorities of requirements for packaging materials which not only should be manufactured from materials that can be reused or recycled, but when they are used and manufactured to produce as less as possible solid waste.

Participation of the scavengers of recyclable and reusable materials in the SWM system

Another important aspect of the Brazilian legislative framework is the effort done to integrate the quite significant informal sector (estimated as almost a million people) in the Solid Waste Management procedures.

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The authors encourage all readers to visit ISWA's knowledge base (http://www.iswa.org/en/525/knowledge_base.html), which contains more than a thousand articles, presentations and technical studies, many of which were used as sources for the realization of this document. Indicatively, they are proposed for studying the following:

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STATUS PART

Introduction

Within the planning process, it is of prime importance to collect baseline data in order to determine the requirements of designing and implement an appropriate SWM system. This includes not only the physical state of local waste resources and infrastructure, but also relevant legislation, existing policies and current waste management activities. It is also the stage where stakeholders are identified and in which a deeper understanding of the underlying causes of existing problems is established.

In general the role of the Status Part in SWM Planning is to:

- gain an overall understanding of the area profile
- identify key stakeholders
- define the current SWM system from every aspect, including physical, organizational and financial terms and examine the cooperation and functioning of both the hardware and the software of the current SWM system.
- estimating the affordability range of the current SWM system
- produce waste flow models (projections)
- evaluate the performance of the current SWM system (indicators of performance) and indicate "areas" of improvement and actions that shall be included in the planning part

Conclusively, an assessment of the present waste management system using the ISWM aspects gives the opportunity to make a collective diagnosis of the kind of existed problems related to waste management. It is a basis for the development of a Master plan to improve waste management.

'If you don't measure it you cannot manage it'

Management of Information

Background Data & Information

In early stage of the planning process there is a need to collect and manage a wide range of information and data needed to develop a sustainable SWM plan. Information usually covers a wide range of topics and is not limited to only waste generation. Usually this information is defined as background information or contextual information. Information provided in the status part differs between national and regional/local plans. Usually, the load of information utilized in regional/local plans is wider and more detailed than information and data used in national plans that tends to be more general.

It is essential to collect as much information as possible in order to gain an overall understanding of the current situation at the area of interest (general profile). This is further supported by the fact that SWM plans are not limited to the implementation of sustainable SWM systems, in the area of interest, but they might lead to Sustainable Residential/Social/Financial Development or to the opposite results. [1]

Obtain Data & Information

Data collection on SWM planning relies strongly on the use of administrative data collected for licensing and monitoring purposes such as facility register, consignment notes or waste management reports. However, due to wide variety of waste treatment operations and waste streams, data often have to be drawn from different sources, which make the harmonization of definitions, classifications and reporting requirements an important issue.

In general, information for the baseline assessment can be obtained from a wide variety of sources and should roughly focus on the following categories of data:

Existing Data: It is extremely likely that a high proportion of data required are already available. Potential sources of available data are as follows:

- *Administrative Records*
- *Secondary Data*

'Create' Data: When the existing data are not sufficient to be used in the planning process, extra data shall be collected using one or more of the alternative methods described below:

- *Observation*
- *Interviews*
- *Surveys.*

For all data collection tasks it is essential to ensure that sources are reliable as possible. It is helpful to cross-check sources (eg compare data from waste collection authorities with that from the disposal authority) and to double-check that the time period to which data relate are compatible (eg financial year, calendar year etc.). [2]

The role of Authorities

In carrying out the baseline assessment, Authorities should:

- identify the sources and contacts required to gather the necessary information;
- oversee, coordinate and, where possible, participate in the collection of information;
- provide facilities and resources for an efficient system to store information and enable access for interested members of the general public; and
- establish a list of stakeholders and a platform through which they can participate.

It is not necessary for an Authority to do the baseline assessment single-handedly. Various organizations, such as universities, research institutions and private consultants can assist with many of the tasks, including data collection and information analysis. [3]

Sampling Issues

If a detailed analysis of the current situation in the planning area cannot be carried out to the whole area, it is preferable to take a sample by identifying a sub-set of the 'population' that you are interested in (target population). A target population might for example refer to all the households in a local authority or partnership area, or it may be all the

households in a 'hard to reach' population, or it may be 'low to medium recyclers', or it may be all the households living within a particular waste collection round. The target population may not necessarily be people or households (it could, for example, be all the household waste recycling centres in a county).

The utility of the sampling is that enables to make reliable generalizations about the whole target population. Therefore it is essential that the sample is representative and mirror the profile of the target population.

Define Baseline

The section provides guidelines on the data that shall be collected in order to set the baseline which will be further analyzed, evaluated and utilized in the planning part. The following aspects are described:

- Demographics
- Socio-economic conditions
- Current policies
- Institutional setup of waste management
- Waste baseline
- Current SWM practices & infrastructure
- Economics & Financing of the Current SWM System

Demographics

Demographic data is required to develop projections in the future. This is also essential information to:

- Ensure that previously unaccounted areas, such as informal settlements are considered; Include seasonal variations of population e.g. due to toursim
- Form the basis for projected waste volumes and types;
- Evaluate of financial recovery
- Assess the requirement for waste management services and infrastructure.

Socio-economic Conditions

Socio-economic data and information provide useful background on factors that influence the quantity and composition of waste arisings and the likely reactions of the community to waste initiatives. [2]

In order to determine current waste generation rates, future waste quantities and to estimate recoverable materials, the socio-economic distribution needs to be identified. Typical categories are:

- High income and Low population density areas;
- Middle income, middle population density areas;
- Low income, high population density areas;
- Informal settlements

These data and information can be used to explain past trends in data, and to help compare authorities' performance or level of waste arisings, or explain the basis of decisions to other stakeholders. In addition, when linked to information of per household/per capita arisings, data concerning new housing developments can facilitate forecasts of waste increase. [2]

It is important to correlate each category of income or each area with different special waste production (kg/inh/ day or per year) in order to obtain a more or less realistic approach of the overall waste generated. For more see later at the paragraph about Waste Amounts

Current Policies

A wide range of policies could be available at international, national, and local level. At international level, various multilateral and bilateral treaties and agreements, including Basel Convention, are available. National policies may have more than one perspective: they may help to improve SWM with respect to local conditions and/or they may assist to comply with international treaties and agreements. Furthermore, local policies could have an importance as in many countries, SWM is a local issue dealt by local governments. *The aim of these guidelines is to collect existing national and local policies.* [4]

Policies are translated into legal and economic instruments for their implementation. Therefore, it is essential to provide information concerning current waste policies and data about available legal and economic instruments.

Institutional Setup of Waste Management

In this task there is a great need to collect detailed information on all the institutions, currently responsible at any level of the solid waste management chain to identify their role or mandate, institutional framework, human resources and sources for financing their activities.

Traditionally solid waste management is the responsibility of national governments which usually bear the responsibility for the development and enforcement of an appropriate policy framework as well as overall environmental legislation.

At the local level the municipalities are usually responsible of implementing and guaranteeing a functioning solid waste management system. These responsibilities may include: [5]

- Maintaining an adequate level of hygiene
- Assuring public waste containers and their maintenance
- Assuring collection, transport, treatment and disposal of waste
- Preventing accumulation of wastes in non designated public areas through enforcement of regulations
- Preventing illegal transport and disposal of waste.

Waste Baseline

In order to be effective, a SWM Plan should have a clear view of the waste produced in the studied area, because knowing where you are today is the first step in understanding where you need to be and of course, knowing if you've arrived.[6]

This subsection aims to highlight the importance of knowledge of waste sources, streams, amounts and composition of the studied waste management system. The aforementioned parameters are basic for many purposes especially for assessing the efficiency of the current system, identifying its shortfalls and constraints, but also for designing the next steps, included in the Planning procedure.

Waste Sources

The definition of waste sources is really important for a WM system since it provides information about who is producing what and which are the produced amounts. In that way, Waste Managers can:

- focus on specific waste sources;
- can identify areas that face problems and deal with them more efficiently.

In addition, knowing the quality and the quantity of solid waste generated, it is possible to conduct recycling or zero waste campaigns, focusing in sources that produce the most wastes or specific target materials. [9]

Waste Streams

Knowledge of waste streams plays an important role not only in the assessment of the current SWM situation but in the planning part of a SWM Planning procedure. Having this type of information, namely knowing the main waste streams and their amounts, waste managers can monitor the efficiency of the current system, but also can set targets to achieve in future, especially for the recovery of specific materials. In addition, knowledge of waste streams can benefit waste reduction and recycling, since it can enable recyclers (especially those of the informal sector) to take action, especially in identified sources of specific streams. [8, 9]

Box 5 presents indicatively and not restricted examples of waste streams. [9, 10]

Box 5: Examples of waste streams

Municipal Waste, Residential Waste, Commercial Waste, Construction and Demolition (C&D) Waste, Industrial waste, Waste of electrical and electronic equipment, Hazardous waste, Industrial Waste, etc.

Amount of Wastes

One of the most important parameters of SWM is the quantity of waste to be managed. The quantity is the parameter determining the size and number of functional units and equipments required for managing the waste. In that view, it is a key – component of any planning procedure and its estimation needs to be documented with all different tools available.

Waste quantities are measured in terms of weight and volume. The weight is fairly constant for a given set of discarded objects whereas volume is highly variable. Waste quantities are usually estimated on the basis of past records of waste generation – in case such records do not exist demographics and social conditions must be utilized in order to create a suitable model for an approach of the generated quantities. Other methods commonly used to assess the quantities are (i) load count analysis; (ii) weight volume analysis; and (iii) material balance analysis. [7]

Measuring quantities and characteristics aims at ensuring adequate capacity for waste collection, recycling and disposal. The waste service must be able to cope with daily and seasonal fluctuations, so measurement of variability is important. Maximum and minimum values are of interest, not just average values.

Waste Composition

Knowledge of waste composition can have a similar action to the knowledge of waste streams. Information about waste composition helps to understand where there is potential to recycle more and detects the quantities of biodegradable materials available. Furthermore, waste composition's importance is becoming obvious when decisions regarding treatment and disposal methods have to be made. In this case specific composition characteristics like humidity, organic fraction content and calorific value are becoming key-parameters for selecting appropriate technologies.

Most surveys related to waste composition distinguish materials between: organic matter, paper & cardboard, plastic, glass, metal, other.

Current SWM Practices & Infrastructure

Waste Collection & Transport

Systems for collection and transport of all waste streams should be included in the description and, if possible, it should be combined with a statement of the responsible parties for the collection and transportation. [9]

At national level a general outline of the waste collection and transport systems is sufficient. However, in regional/local level a more detailed analysis is required. It is essential to assess the following baseline service level for both collection and transportation.

Waste Recycling

This section of the status part shall define the quantity, type and quality of materials being recycled and describe the operating recycling facilities. Especially, recycling systems shall be described as follows:

- Material recycled (e.g paper, plastics, metal etc)
- Existing recycling facilities (location, capacity, treatment, age etc.)
- Organised collection of reusable material (area served, waste type, quantity, collection method, frequency of collection);
- Informal collection of reusable materials
- Market for recycled materials
- Recycling costs
- Recycling Companies

Waste Treatment

The description and evaluation of the existing waste treatment facilities is crucial for the planning process. It will define 'infrastructure gaps' and will inform the need to procure new facilities to cover present and future needs.

Treatment systems are broadly categorized as follows:

- Mechanical treatment
- Biological treatment
- Thermal treatment, including incineration, pyrolysis and gasification.

Waste Disposal

Existing final disposal practices for solid waste in most countries around the world is disposal on land either with the form of sanitary landfilling or uncontrolled dumping. These types of disposal might include the disposal of the mixed solid waste or the residues of the waste being treated in waste treatment facilities.

The status part shall include the following waste disposal information:

- Number of waste disposal sites (number of sanitary landfills and number of uncontrolled landfills)
- Areas served by the recorded disposal sites
- Size of the recorded disposal sites
- Amounts and type of waste disposed at the sites
- Type of pretreatment before disposal for each site
- In the case of scavenging, an appreciation of the number of scavengers working at the site and the amount of waste being recovered.

Economics & Financing of the Current SWM System

Economics

Waste Management economics concern a considerable amount of money, most of which is consumed in waste management system's elements, such as collection, treatment, disposal, etc. Independently from the amount spent on the above procedures, an appropriate SWM system should locate the necessary funds so as to be developed and modernized, adapting itself to the changing conditions of waste production and complexity.

A SWM Plan is actually characterized from the area it studies. For this reason, especially when the coverage area is big, e.g. a national Master Plan, it is difficult to provide an analytical presentation of the financial data of the existing WM system, since it is both time demanding and it may present great deviations, due to the extent of the coverage area. However, it should provide summarily indicative costs of the main activities, such as cost per tonne disposed, cost per tonne collected, etc., providing to the public a clear view about the current financial situation of the SWM and establishing in that way a basis for comparison with the actions that will be proposed in the Planning Part of the Master Plan. Nevertheless, in case that a Master Plan studies a smaller area, it is possible to have available more information related to the waste management system and therefore it should provide it. Indicatively, local plans can provide data about: the cost per tonne collected; the cost per tonne treated in various facilities (thermal, biological, separation, etc.); the distributed collection cost of specific target materials – especially those collected by recycling schemes -, etc.

Financing

As for financing, most places of the world use combinations to sustain their SWM systems, including operation of units from private and public entities, inter-municipal partnerships, consortiums and private-public partnerships. Financing of a SWM system depends heavily on the existing legislation of the coverage area. Therefore it is suggested a SWM Plan to mention clearly the existing funding arrangements, both in terms of payments to the service provider and charges to the service users, to avoid breakdowns and malfunctions of the system. More specifically, financing of the existing waste system and practices should be described as follows:

- Funding mechanism for collection, treatment, and disposal. For instance user charges, authority taxes, income from the sale of recovered materials, loans, and other financing sources.
- Current unit fees/user charge for collection, treatment and disposal of waste.
- Current major problems experienced in the financing of the waste management services, such as non-payment; money raised for waste management is used to cover shortfalls in other services; etc.

Evaluation of Current Situation

This section presents practical advice and tools on how to evaluate the performance of the current waste management system in the area of interest. An essential prerequisite is to have completed the collection of data and information as they have been described previously.

The evaluation process not only will enable authorities to assess whether schemes are performing well, it will also help diagnose problems, design new approaches and ultimately improve efficiency and effectiveness of the current SWM system. In addition, it will assist local authorities to reduce waste and recycle more, making better use of resources and helping to tackle climate change.

In order to perform the evaluation the following steps shall be taken:

Step 1: Identify roles of Key Stakeholders in SWM planning

Step 2: Evaluate Hardware & Software of current SWM system

Step 3: Create Waste Flow Models

Step 4: Estimate Range of Affordability

Step 5: Set Performance Indicators

Stakeholders in the Baseline

As it was mentioned in previous chapters, stakeholders are a basic element of Solid Waste Management Planning procedures. When defining the baseline, it is of great importance to identify all the involved stakeholders, to define the key interest of each one and to assess what can be his contribution to the draft of the baseline.

Define Strong & Weak Points of the Hardware & Software

As it has already mentioned a sustainable SWM system requires the good functionality of both hardware and software of the system and their harmonious cooperation. In this sense it is important to evaluate their performance in the current SWM system and to address potential problematic and/or strong areas of interest. The results of the evaluation will form the baseline of indicating the necessary improvements that shall be performed and included in the planning part.

Create Waste Flow Models (Projections)

Having collected all the data related to the waste of the studied area, before moving to the draft of planning scenarios, it is essential and indispensable to determine the input parameters for the scenarios. This is done by making projections of the waste data and more specifically of waste amounts and composition.

The main factors determining annual waste generation and composition are the population and the living standard of an area. The assumptions usually made for the first parameter consider that the more the population, the bigger the waste generation will be. As for the second parameter, things are a little more complex, since higher living standards indicate both an increased waste generation and a more complex waste stream, namely with smaller presence of biodegradable fraction and increased presence of recyclables.

Valid waste projections are very difficult to be conducted and many times it gets really difficult to prove their reliability. Until today, many SWM planners conduct projections using the time-series approach, according to which past data and their distribution are used to determine waste flows in the future. However, this method seems to evolve with the addition of certain factors, which take into consideration others parameters too, such as the changing trends in socioeconomic conditions, in the use of cleaner technologies, etc.. This approach aims not only to make predictions for future waste flows and synthesis, but also to unveil hypothetical causal relationships between factors and waste data.

Box 6 mentions indicative parameters that should be taken into consideration when conducting waste data projections.

Box 6: Indicative parameters affecting waste flows and waste characteristics

- Changes in population
- Changes in household size
- Changes in GDP/capita
- Domestic migration
- Achievement of Recycling targets
- Evolution of targets set by the legislative framework
- Promotion of cleaner technologies
- Appearance of new materials
- Technological development

Typical waste flow models are presented below in the form of excel graphs are summarized in figure 16.

Figure 16: Typical waste flow models [13]

Define Affordability Range

In order to design an affordable solution in the planning part there is a great need to estimate the following important parameters that results from the setting of the baseline:

- Prospects of economic growth in the area of interest
- Gross Domestic Product (GDP)
- Cost of the Current SWM

Economic affordability requires that the cost of waste management systems are acceptable to all sectors of the community served, including householders, commerce, industry, institutions and government. The costs of waste management systems shall be closely and carefully evaluated, as systems that are not financially viable often quickly become expensive failures with significant negative impacts on both the environment and the local population.

GDP & Waste Budget

As it has been mentioned waste generation is linked to both population and income growth. Of the two, income level which is measured in terms of GDP is the more powerful driver.

But even more helpful is the data that divides the total municipal budget for SWM by the population, and then expresses that as a percentage of the gross domestic product (GDP) per capita: Most of the world's cities waste management spending are in the range of 0.1 to 0.7 % of GDP/capita. [13]

The percentage of the waste spending relative to GDP may be similar for developing and developed countries (looking at specific cases), but there is a significant difference in the amount spent on waste management expressed in per capita terms. Dhaka city, for example, spends US$0.9 per capita per year (0.2 per cent of GDP) on MSW management whereas Vienna spends US$137 per capita per year (0.4 per cent of GDP). [12]

Another major phenomena to note is that developing countries typically spend more than half of their waste budget in collection alone (mainly on labour and fuel), although the collection rate remains low and the transport of waste inefficient. Spending on other segments of the waste management chain such as appropriate treatment, recovery and disposal technologies and facilities is generally rather low. In these countries, increased investment in basic collection services, the transport of waste and cleaning up dumpsites is a starting point for sustainable SWM.

In this sense it is considered that for sustainable waste management system, the range of spending must be between 0,3%-0,5% of GDP/capita. Next figure presents typical spending distribution in different countries.

Figure 17: Typical spending distribution in different countries [12]

Estimation of Performance Indicators

A critical action prior to SWM planning is to evaluate performance of the current SWM system using performance indicators. SWM performance indicators are quantifiable measures that encapsulate critical success factors and are a framework for evaluating SWM systems. They are presented as units of measurement (e.g. number, percentage, tonnage) and their calculation is based on collected data in the status part. In addition, the accuracy of their values is strongly related to the accuracy and credibility of the used data.

Indicators that provide a quantifiable measure are preferable, although there is sometimes a place for qualitative indicators. In the absence of reliable data on direct measures, proxies may be useful.

Basic performance indicators are presented as follows:

Technical performance Indicators

- ⇨ Collection rate (% of waste collected of total amount generated)
- ⇨ Collection coverage (Number of people served as a % of the total population)
- ⇨ etc

Indicators of Cost Effectiveness

One way in which the community can be given more information is through the use of soundly based cost-effectiveness indicators, such as the cost of achieving higher rates of recycling or lower rates of disposal to landfill. Improved information on cost-effectiveness would be beneficial to policy makers at all levels of government and to the community in assessing the costs of different waste management options. Moreover, cost-effectiveness indicators would assist in ensuring preferred waste management options are implemented at least cost.

- quantity of waste processed per total cost
- cost of collection per total waste generation
- etc

Environmental Indicators

- % of waste collected which is disposed of in a sanitary landfill
- Health status of the population measured by prevalence of waste/excreta related diseases such as hepatitis A, typhoid/paratyphoid, cholera, amoebic dysentery, ascariasis, schistosomiasis, filariasis
- Amount of carbon dioxide per amount of waste diverted from landfilling
- etc

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PLANNING PART

Introduction

Planning part is the core of ISWM. The planning process is a critical way to engage stakeholders, as well as to move beyond crisis management.

Planning for ISWM means adopting policies and plans for waste management that include: (1) participation of stakeholders; (2) all six aspects of ISWM and (3) all waste system elements. The basis for ISWM planning is the baseline assessment described above, to analyse and document the existing waste management system, work with clients and stakeholders to evaluate its functioning; identify resources and needs; and the like.

SWM planning is a continuous process and not a one-time or quantum activity. The process should begin with a situation analysis, i.e., an assessment of the internal as well as the external environment. This assessment of the existing situation is the basis for articulating criteria; setting goals, objectives, targets and indicators; formulating a plan of action to meet targets and objectives. Action plan has to be then monitored to check if targets have been attained or not. In case targets are not achieved, the process should be repeated till the desired targets are met.

Planning

The vision of the plan/Overall Goal

A SWM plan needs to set out a `vision/overall goal' of what it intends to achieve. Once the vision has been defined and agreed between all key stakeholders, it will act as a platform from which to develop a shared understanding of the objectives of the SWM Plan.

For example, the vision might refer to the followings:

- ⇨ to lower the costs and risks of waste to society;
- ⇨ to reduce environmental damage and harm caused by waste generation and disposal;
- ⇨ to increase economic benefit by using material resources more efficiently;
- ⇨ etc.

An overall goal is a long-range aim for a specific period. It must be specific and realistic. Long-range goals set through planning are translated into objectives which in turn are translated into targets and actions.

Definition of the scope of the plan

The boundaries of the plan need to be clearly defined. This will involve making decisions on the planning area, period and types of waste to be covered by the plan.[1]

Planning Area

The planning area is usually defined as the geographical boundary of the area that has to be served by the waste management system. The planning area needs to be broad enough to capture both the major centers of waste generation and the area of search for disposal sites. Many factors will influence the decision on planning area selection.

Box 7: Selecting the Planning Area [2]

Geographical: Physical size of the urban area, topographical characteristics, location of existing waste management facilities

Demographic: Population of the urban, population density, number of households, population growth rate (or decline)

Economic and Financial: Budget available for waste management, tax revenues, socio-economic profile of the population to be served, economic growth projections, potential for cross-subsidizing services for lower income areas by wealthier areas.

Institutional: Local and regional governmental arrangements, land use planning situation, relationship with neighboring authorities, political commitment to waste management.

During the selection process it is essential that all reasonable opportunities for regional planning and shared use of facilities should be explored. Moreover, in municipality level, authorities shall consider shared waste management arrangements with neighboring municipalities as a means of reducing SWM costs.

Planning Time Period

The SWM plan is usually defined as covering 15-20 years in order to cover issues in the long-term. A time horizon of 5 years can be established for the Action Plan. The whole SWM plan should in any case be reviewed at least every 5 years to ensure that it remains current.

The plan must set out a long-term strategic vision in line with local, regional and national expectations which should be set out in a high-level document. If local authorities are considering procurement of a waste management contract they should ensure that the plan covers a sufficient time period to prove attractive to investment while seeking not to constrain movement up the waste hierarchy.

Type of Waste Covered by the Plan

Planners will also have to decide which types of waste to include in their Plan. For example, shall the plan include non-hazardous industrial waste or only commercial waste? What will be the link to sewage sludge disposal etc. [1]

In principle, the plan shall cover all the types of solid waste generated within the planning area, regardless of their management responsibility. However, it is likely that the municipal solid wastes will generally be classified as the priority wastes that the SWM plan shall consider in greatest detail.

Setting objectives & targets [3]

Setting Objectives

The major outcome of SWM planning after gathering all necessary information, is the setting of objectives based on the overall goal of the SWM Plan.

Setting objectives involves a continuous process of research and decision-making in which knowledge of the current situation on SWM is a vital starting point.

General objectives such as mentioned below are often identified in SWM plans:

- ❑ diversion of (biodegradable) waste from disposal (landfills)
- ❑ increase recycling
- ❑ control the pollution from waste to the environment

- increase cost efficiency in waste management
- waste reduction

Setting the right objectives is critical for effective performance of SWM.

> ***Setting objectives & targets can be led by the stakeholders in a facilitated discussion and in co-operation with experts who give their opinions and methodological advice and comment on the results.***

During the planning process objectives shall be divided into short-term objectives (usually 1 to 5 years) and long term objectives (i.e. 5 to 12 years)

Setting Targets

Targets are the tools used in SWM planning in order to materialize the objectives and usually relate to the performance and coverage of SWM services. As long as they are realistic, can be an effective tool for driving forward improvements. In some cases, SWM targets have been established within National Policies or Sector Strategies. [1]

Targets shall be 'SMART' which means that they must be:

- ***S*** pecific
- ***M*** easurable
- ***A*** chievable
- ***R*** ealistic
- ***T*** ime-bound

Box 8 explains in what way goals shall be SMART.

Box 8: SMART Targets in SWM planning [4]

SMART targets are specific, measurable, achievable, realistic, and timely:

- Specific targets are straightforward and unambiguous. They emphasize what you want to happen.
- Measurable targets are explicitly defined so you know when you've met them. Terms like "as much as possible" or "soon" are not as measurable as "reduce by 5 percent" or "by the GDP."
- Achievable targets are reasonable and attainable. Because they are specific and measureable, there should be no ambiguity as to whether the goals are practical. Unachievable targets will risk losing the credibility of target setting.
- Realistic targets are those authorities and public are willing and able to work to implement. A feasibility analysis, or at least an estimate by experts, is needed to set realistic targets. Industry standards, benchmarks and a comparison to what other similar countries/cities have achieved in the past can also give some idea of it.
- Timely targets set a timeframe and schedule to ensure that work can get done within a specified and realistic timeframe. Targets need milestones or timetable, which will set stages to be reached by given deadlines thus rendering little motivation for timely implementation.

Depending on waste streams targeted and the type of targets opted for target setting process can vary from case to case. Availability and quality of baseline information and projection, the desired level of requirement of the SWM, and the capacity and resources available for the project are basic factors of forming the right targets.

Considerations for Developing Objectives and Targets

When establishing objectives & targets, the following aspects shall be taken under consideration:

- ✓ legal requirements under existing legislation;
- ✓ significant environmental impacts;
- ✓ technological options;
- ✓ financial and operational requirements; and
- ✓ views of interested parties.

In addition, choice of objectives and targets for SWM planning needs to take certain factors into account:

- ⇨ National, provincial and/or city's overall strategy and plans related to waste management
- ⇨ Social and economic development plans
- ⇨ Industrial development plan
- ⇨ Relative importance or urgency of each goal

Prioritization of Objectives & Targets

Objectives and targets shall be listed and prioritized. [5]

The list of objectives and targets is likely to be long and very demanding in both costs and human resources. Some objectives and targets may conflict with others. Hence, an impartial prioritization technique should be applied to select which objectives and targets will be given preference. Methodological consistency is vital to arrive at reliable results.

Priorities can be set at various stages of SWM planning:

- ⇨ setting priority problems;
- ⇨ setting priority objectives;
- ⇨ setting priority targets/actions

The prioritization methodology depends on what is being prioritized, the availability of data, the degree of participation in the SWM planning and the time and resources available.

Prioritization can be made easy by ranking. Ranking can be in the form of High, Medium or Low based on various factors such as long term benefits, short term benefits, self reliance, growth of the community, equitable sharing of the outcomes, and financers multiple benefits.

Communicate Objectives & Targets to Stakeholders

Achieving the target requires combined efforts of government and industry at all levels. It is therefore imminent to consult them, the objectives and targets together with the rationales behind, before finalizing.

In addition, setting objectives and targets should involve people in the relevant functional area(s) in order to build commitment. These people should be well positioned to establish, plan for, and achieve these goals.

Tracking Options

The purpose of this step is to identify the practical options (or alternative solutions) available for addressing each of the component parts of the overall Solid Waste Management System in order to satisfy objectives and targets set in the planning process.

Many SWM systems have been implemented worldwide. Although the identification of the different SWM systems and sub-systems is an easy

process, the selection of the proper systems meeting the unique needs of the planning area is a harsh one.

An integrated SWM system often consists of the following stages:

- Waste collection (mixed, source separated, etc)
- Waste transfer (to transfer station, recovery and recycling facility, treatment plant or landfill)
- Waste collection at transfer stations
- Waste mechanical separation (material recovery and recycling facility)
- Waste treatment (thermal, physical, chemical or biological treatment)
- Waste disposal to landfill

Notwithstanding the above, every waste management system must operate at a cost acceptable to citizens, businesses and government. The costs of operating an effective system will depend on existing infrastructure, but ideally should be little or no more than existing waste management costs.

In this sense the following categories of options shall be identified:

- Institutional Options
- Technical Options
- Financial Options

Box 9 presents important parameters of setting up a SWM system in developing and transition countries according to the principles of moving waste up to the hierarchy.

Box 9: Key Issues of Setting Up a SWM system in developing and transition countries [18]

- *Phase out dumping*. The approach that will bring the greatest improvements to the present situation is to lift the local waste management system onto the first stage of the waste management system by upgrading the standards of SW disposal. This means introducing 'control' to waste disposal practices.
- *Preserve & Build on the informal material recovery system*. Many countries have thriving secondary materials markets. In light of these, systems designed from the 'top down' to institutionally stimulate avoidance, minimization, separation and recycling of municipal solid wastes of interfere more with function systems than they help. Informal material recovery systems optimize the use of natural resources, create employment and income and reduce the quantities of waste requiring collection and disposal. The most viable option is to support the informal recovery sector while in parallel developing a SWM system based on the appropriate technological solutions and practices.
- *Move practices up the hierarchy*. SWM management practices shall be selected in order to move up the waste hierarchy
- *Long term approach*. The historical progression of waste management systems with on-going economic development of a country, the attraction of the secondary materials recovery sector as a mean of employment and income generation will decrease. Consequently there will be an increasing need for governments and municipalities to stimulate, from the 'top down' the movement of SMW up the hierarchy.

Institutional Options

Effective organization and management is required to sustain an effective SWM system. When planning for improvements in the SWM system, attention needs to be placed on ensuring that institutional responsibilities are clearly define, and that institutions are both sufficiently resourced and accountable for their performance. In order to do so different schemes of forming or improving the institutional framework shall be defined.

Waste Collection & Recycling Options

This component is mainly focus on identifying and selecting the appropriate operating sub-systems options regarding:

- Waste storage
- Collection
- Transfer
- Cleaning Services
- Vehicle Maintenance
- Material Recovery & Recycling
- Others

Collection & recycling systems may play an important role in the achievement of targets, so consideration on which type of system is the most appropriate in view of the targets should be made. For instance a kerbside collection system may be more effective than a system where the individual waste generator must bring the waste to a central recycling site. A kerbside collection system, however, is more expensive. [6]

Waste Treatment & Disposal Options

Planners shall provide a list of the available SW treatment technologies and disposal techniques. A wide range of treatment technologies are available on the market including and not limited to the following waste treatment options:

- Sanitary Land filling
- Waste to Energy (Incineration)
- Centralized Composting
- Anaerobic Digestion
- Others

They shall afterwards describe some of the more mainstream technologies available and highlight their potential applicability in the planning area.

Planners shall be realistic about the viability and practicality of selected SW treatment technology. In the past selection of inappropriate treatment technologies led to the failure of the SWM system in the area of implementation.

Financial Options

Are described in detail in the following sections.

Option Analysis

This section is the core of a SWM plan, since the basic technical aspects of the integrated waste management system are determined. More specifically, in this phase:

- Waste management zones, which will receive common waste management services are determined
- The locations or the wider areas of the main waste management infrastructure are selected, with emphasis on

the central waste management facility, which will comprise of the landfill and the waste treatment plants

- ⇨ The collection system that will be implemented will be selected
- ⇨ The technologies that will be implemented for the treatment of the waste will be selected
- ⇨ The main financial aspects of the system will be presented

Create Scenarios

Based on the principles of scenario planning, effective schemes of a combination of SWM options shall be created. Scenarios need to provide flexibility to design, adapt and operate systems in ways which best meet current social, economic and environmental conditions. These are likely to change over time and vary by geography.

Alternative scenarios might refer to different major categories such as:

- ⇨ Alternatives in terms of technical waste treatment / management
- ⇨ Alternative locations of waste management infrastructure (referring mainly to waste treatment plants, material recovery and recycling facilities, waste transfer stations and landfills)
- ⇨ Alternative zoning in terms of common waste management (management zones) as well as the number/capacity of waste management facilities (referring mainly to waste treatment plants, material recovery and recycling facilities, transfer stations and landfills)

Assessment of Scenarios/Options

After the relevant range of scenarios/options is determined technical and financial assessment will come up with the best scenario to meet the objectives and targets established in the previous sections.

Here are some suggestions regarding to principles can guide the decision makers in order to formulate their own criteria and procedures.

Suggestion 1: Be aware that scenarios have to be developed in a uniform way, they will be based on the same assumptions and they will include the same information. The best way to do it is to summarize scenarios in assessing certain quantified or semi-quantified indicators. Unless scenarios are constructed in that way, they will not be comparable.

Suggestion 2: Ensure that the data required to make a comparison between different scenarios is already included in their description. As n example, if the recycling rate of plastics is one of the criteria for scenarios' assessment, it has to be estimated for each scenario and described in its development.

Suggestion 3: Pay attention to the way criteria are combined in order to have a final decision. Usually, several criteria are defined like financial, environmental, technical, social etc. The problem is how those criteria are combined between them in order to create the decision – making tool. A usual way to confront that problem is to link criteria with specific weights (%). The sum of all specific weights must be 100% and in order to have the final ranking of each scenario, the rank of each criterion is multiplied by each specific weight and the sum of all products gives the final rank. In this case there is always a lot of subjectivity involved and a lot of objections might be delivered, especially when stakeholders, or some of them, are not actually involved in decision – making. A way to overcome that problem is either to create an inclusive decision – making) which might be too slow or never – ending sometimes) or to create a decision – making system with ranges of specific weights (instead of exact figures) and deliver results with ranges too.

Here is an example for effective scenario making regarding the selection of an appropriate technology [19]. Two phases of work are proposed:

PHASE 1
1. CREATE A PROFILE OF THE EXAMINED AREA
2. CREATE A PROFILE FOR THE EXAMINED TECHNOLOGIES
3. CREATE A PROFILE FOR THE PRODUCTS OF EACH TECHNOLOGY SCREENING

PHASE 2
4. CREATION OF COMPLETED SCENARIOS
5. EVALUATION CRITERIA
6. COST – BENEFIT ANALYSIS

Systems Analysis Tools

There is a large number of different 'Systems Analysis Tools', supporting waste management decisions. These tools can be either procedural or analytical. Procedural tools focus on the procedures and the connections to its societal and decision context, whereas analytical tools focus on technical aspects of the analysis.

The choice of the appropriate tool in different situation is largely decided by two aspects: the object under study and the impacts of interest. Some of the most useful tools in waste management decision making process are describes as follows:

Environmental Impact Assessment (EIA) & Strategic Environmental Assessment (SEA) are both procedural tools. EIA is an establishes tool mainly for assessing environmental impacts of projects. It is generally a site-specific tool. The locations of the planned project and associated emissions are often known and an EIA is often used to evaluate alternative locations. It is requires in different regulations in many countries, e.g. in order to get a permit for a waste treatment plant. SEA is a more recent tool intended to be used at an earlier stage in decision making process, on a more strategic level. It is intended to be used for policies, plans, and programmes.

Since EIA and SEA are procedural tools, different analytical tools may be used as parts of the process.

Both EIA and SEA typically include environmental impacts as well as the use of natural recourses. It is sometimes suggested to include economic and social aspects as well in a broader sustainability assessment. [10]

Life Cycle Thinking & Assessment

Over their life-time, products (goods and services) can contribute to various environmental impacts. Life Cycle Thinking considers the range of impacts throughout the life of a product. Life Cycle Assessment quantifies this by assessing the emissions, resources consumed and pressures on health and the environment that can be attributed to a product. It takes the entire life cycle into account – from the extraction of natural resources through to material processing, manufacturing, distribution and use; and finally the re-use, recycling, energy recovery and the disposal of remaining waste (See Figure 18). [9]

The fundamental aim of Life Cycle Thinking is to reduce overall environmental impacts. This can involve trade-offs between impacts at different stages of the life cycle. However, care needs to be taken to avoid shifting problems from one stage to another.

Reducing the environmental impact of a product at the production stage may lead to a greater environmental impact further down the line. An apparent benefit of a waste management option can therefore be cancelled out if not thoroughly evaluated.

Figure 18: Life cycle thinking [9]

Waste management is an area where local conditions often influence the choice of policy options. Life Cycle Thinking and Life Cycle Assessment can be used to weigh up the possible environmental benefits and drawbacks linked to policy options in a specific situation.

Typical questions that can arise in local or regional settings include:

- Is it better to recycle waste or to recover energy from it?

  What are the trade-offs for particular waste streams?
- Is it better to replace appliances with new, more energy efficient models or keep using the old ones and avoid generating waste?
- Are the greenhouse gas emissions created when collecting waste justified by the expected benefits?

Cost–Benefit Analysis (CBA) is an analytical tool for assessing the total cost and benefits of alternative option in a project or policy.

The benefits of an option are contrasted with its associated costs (including the opportunity costs) within a common analytical framework. To the extent that is possible, all costs and benefits should be expressed in a common unit or numeraire, and this is monetary value.

The main advantage is that a CBA gives a comprehensive overview of all important effects from a policy or project, and that these effects can be compared through the use of a common unit. By using a common unit for all effects, the benefits and costs of implementing a policy or project can be weighted against each other to help decision-makers choose the alternative that gives the highest net benefit to society. As a general rule projects with a positive net benefit should be implemented; while projects with a negative net benefit should be rejected.

In practice however, not all beneficial projects or policies will be undertaken simultaneously, either because a budget restriction might limit the possibilities, or because the projects are mutually exclusive. Then the projects will have to ranked according to their net benefit.

It should be emphasized that CBA is a decision support tool, not a decision- making tool. The CBA is supposed to provide the best available information about the subject in question. However, not all information can or will be captured in a CBA and decision-makers may also have other political issues to consider, which is why the CBA does not represent “the final truth”. [10]

Life Cycle Costing (LCC) can be used to assess the costs of a product or a service from a life-cycle perspective. It can include different types of costs.

LCC is a method of comparing different options/projects by taking into account relevant costs over time, including the initial investment, future replacement costs, operation and maintenance costs, project revenues, and salvage or resale values. All the costs and revenues over the life of the project are adjusted to a consistent time basis and combined to account for the time value of money. This analysis method provides a single cost-effectiveness measure that makes it easy to compare scenarios/projects directly. [11]

Material Flow Accounting (MFA) is a family of different methods that can facilitate the integration of environmental and economic policies and prove essential to environmental policymaking. [15] MFA focuses on inputs, but it also follows materials within the economic system to trace the outputs.

Impact Assessment is a useful tool that often accompanies different policy proposals. The content and ambitions for such assessments may vary in different countries and they may or may not include environmental aspects. [8]

Prioritization of Project Measures

A number of options were appraised in the previous step to propose an ISWM system.

These measures are prioritized in a series of steps as follows:

- Prioritization of measures, which are required for compliance with national laws over other measures.
- Prioritization of those measures which can be performed within current local capacity
- Prioritization of those measures, which will have maximum impact on targets for improvement of the waste management situation.
- Prioritization of other measures according to other critical need in the SWM system

Action Plan

In this step an action plan will be defined based on the results of the Scenarios Assessment Process. This may be considered as the core - outcome of the planning process.

The action plan shall set out in detail the steps to be taken in implementing each component of the chosen scenario over a specific time period, who should take the actions and when.

Moreover, this plan focuses on the first phase of the project implementation (to be funded during this period of funding) and the respective main infrastructure investments, but it also gives an indication of all future activities (infrastructure or light activities) that will need to be implemented.

Implementation

Instruments for a successful implementation of a SWM Plan

The way that a SWM Plan is implemented defines in great extent how successful it is going to be. The implementation of a Plan by itself plays a crucial role because if the equipment or the facilities that have been designed during the Planning process are not implemented in a proper way, they will not have the expected results.

In order to assure the proper implementation of a SWM Plan, they have been developed certain instruments, covering a wide spectrum of aspects, aiming to integrate the designed changes to the existent SWM system. These instruments are divided according to their content to:

- Policy instruments;
- Legislative instruments;
- Economic instruments;
- Communicative instruments; and
- Organizational/Institutional instruments.

The following paragraphs are analyzing the content of each instrument, its significance and its contribution to the successful implementation of a SWM Plan.

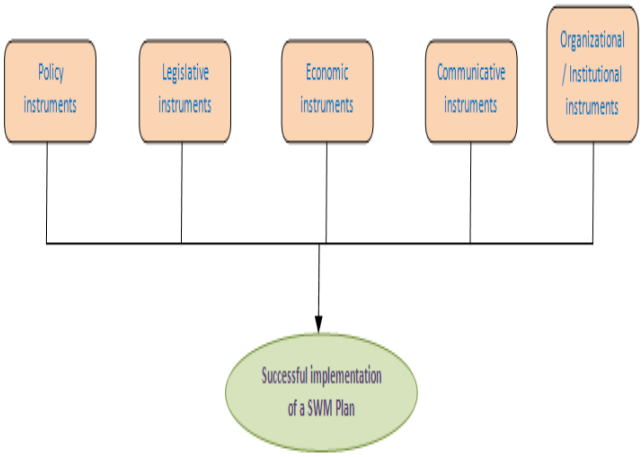

Figure 19: Instruments for the successful implementation of a SWM Plan

Policy Instruments [13]

Policy is one of the most if not the most important element related to the waste management practices of a given area or of a country. The successful implementation of a strategic objective often depends upon the existence of an appropriate policy framework. For this reason, it could be really useful and helpful in areas that SWM Plans are developed, to identify and assess the environmental policy and wherever necessary to adapt it and amend it so as to support the attainment of the strategic objectives.

Indicatively, they are mentioned the following policy instruments:

- The Integrated Product Policy, including measures such as the producer's responsibility, eco-labelling, life-cycle analyses and environmental management systems.
- Environmental agreements between industry and the authorities, to produce environmental friendlier products.

Legislative Instruments [13, 14]

The promulgation of appropriate legislation is critical to the development and successful implementation of solid waste management plans at all levels. The legislative instruments can be used as an extra means of pressure to achieve the strategic objectives that have been set by the SWM Plan. More specifically, this type of instruments provide a legal foundation for regulating the behavior of individuals and legal entities, thus ensuring the legislative basis for implementing the waste management plan, maintaining waste collection and disposal systems, and providing the basis for enforcement and sanctions.

Indicatively, the legislative instruments can define:

- The obligations of the waste generator, the private waste collectors and the waste disposers;
- The percentage of the produced waste to be recycled or landfilled;
- The percentage of a specific stream that will be led for landfilling.

Economic Instruments

The economic instruments used for the implementation of a SWM Plan can perform a double role. Firstly, they can be used so as to ensure that the costs of providing waste management services are recovered, and secondly to influence the behavior of waste generators to cause less environmental pressure, ensuring the same time the preferred direction of the waste stream, i.e. disposal or recycling. Economic instruments may therefore promote optimal utilization of services and provide incentives to reduce waste production. It is generally thought that economic instruments for environmental protection can generate the same level of waste reduction at a lower cost than via the more conventional regulatory approach. [17] Taxes, charges and fees are common economic incentives, without being the only. Subsidies may also be used to create an incentive, with the delivery of end of life vehicles to authorized car breakers to be one of the most typical examples. [6]

Indicatively, they are mentioned the following economic instruments:

- Landfill taxes;
- Fees or charges on waste collection;
- Fees or charges on waste treated.

Communicative instruments

Effective communication is crucial for the overall success and sustainability of a SWM Plan. The best way to raise public awareness around waste management issues is through Information and education.

The SWM development process is vital in securing understanding of the waste challenge and community support for the way solid waste is handled. To ensure successful implementation of the SWM plan it is essential that key internal stakeholders (planning, transport, finance, elected members) are engaged early in the process to ensure that any proposals have the necessary financial and political backing. Authorities should also engage the local community and other external partners innovatively and actively at an early stage. Appropriate consultation should be continued throughout the SWM development process

Information and education

The role of various stakeholders of SWM, such as waste producers (companies and individuals), waste collectors, etc., keeps increasing, demanding in many occasions from them to sort out recyclables, to deliver it to the right containers, etc. In order to achieve an efficient and well-functioning solid waste management system, it is important that the public understands the system and supports it. [6] For the reasons

mentioned above there is a great need for transfer of information across the people, more in a manner of communicating. With the latter it is meant that the specific information should get across the people not as learners but as a target audience. [7]

The information can have two purposes: an instructive one and a motivating one.

The instructive purpose aims to inform people of what to do. It can be information about the correct sorting of waste or it can be information about where to deliver certain fractions of waste e.g. where to deliver used batteries. This type of instructive information will often be a combination of national campaigns and local information.

Organizational/Institutional instruments

It is very common, especially in developing countries, the changes that a SWM Plan requires to differ a lot from the current practices of waste management. For this reason, knowledge of new technology and methods along with the training at all levels is necessary, and this is accomplished with Capacity Building. [7]

Capacity Building [7]

In order to implement, control and monitor a SWM Plan it is required a certain administrative capability at all levels. Capacity building refers to the activities that strengthen an organization or an individual and help it fulfill its mission better. These activities, apart from training, may include among others:

- ✓ Human resource development: the process of equipping individuals with the understanding, skills and access to information, knowledge and training that enables them to perform effectively.
- ✓ Organizational development: the elaboration of management structures, processes and procedures, not only within the organization but also the management of relationships between the different organizations and sectors (public, private and community).
- ✓ Institutional and legal framework development: making legal and regulatory changes to enable organizations, institutions and agencies at all levels and in all sectors to become more proficient.

Building capacities is significant in order to ensure the proper implementation of all the actions determined by a SWM Plan.

Partnerships

The development of partnerships is identified as an important mechanism for providing services and facilities required for ISWM. The categories of partnerships that shall be considered include:

- Public-public partnerships
- Public-private partnerships
- NGO/CBO partnerships
- Private-public partnerships

A number of different types of partnerships can be developed, including:

- Co-operation
- Contracting out of management and/or service functions;
- Leases
- Concessions, including e.g BOT(Built, Operate and Transfer)
- Leases
- Privatisation/transfer of ownership
- Management/ Employee buyout or concession
- Joint ventures

Partnerships in waste management planning shall be encouraged. The formation of Public-private partnerships for the implementation of ISWM plans shall be investigated. Public-public partnerships for smaller local authorities could greatly reduce the cost of equipment and salaries and shall be encouraged. Partnerships in waste collection can prove very beneficial for small local authorities and should be considered for public-public as well as for public private partnerships.

The late years, there is a global trend in adopting Public Private Partnerships (PPPs) in the domain of waste management, especially in municipal level. The trend is bigger in the European continent, where many countries have established PPPs for collection and treatment of municipal solid waste.[2] However, the need for PPPs seems to be more urgent in developing countries, where public funds are limited and inefficient and inappropriate waste management services not only harm the environment, but poses also a severe danger for human health.

Implementation Program [13]

Based on the collected background information, objectives and targets, and the instruments for implementing the SWM plan a SWM implementation program shall be developed. This shall compromise:

- ⇨ An economic analysis of all aspects of the SWM plan
- ⇨ An infrastructure or capital investment plan
- ⇨ An institutional plan
- ⇨ A communication (awareness, information transfer and public participation)
- ⇨ A financial plan

The *Economic Analysis* shall include an estimation of a medium-term projection of capital and operational expenditure. The analysis shall provide budget estimates for achieving the objectives of the SWM plan.

An *Institutional &Organizational Plan* shall be formulated, that is intended to guide institutional transformation and re-organisation of support structures for carrying out the SWM plan and delivering on the SWM objectives. This plan shall include human resource development, and the additional staff required. Alternative options such as partnerships and out-sourcing shall also be considered.

The communication and public participation plan shall detail the communication and public participation process to ensure that the necessary arrangements are in place for stakeholders to be informed about progress and to feed back into the process for the implementation of the SWM plan.

The financial plan shall reflect the SWM priorities identified in the developed SWM plan. The annual budget shall be based on the medium term financial and institutional plans in order to direct and manage recourses in a focused ways, to achieve the goals of the planning process.

The SWM implementation program shall detail the activities to be undertaken, delivery targets and milestones. It will also provide information on project management responsibilities of senior staff and schedules for project implementation.

Monitoring & Review

The Role of Monitoring and Evaluation

Monitoring and Evaluation of the performance of a SWM Plan's implementation constitutes an essential and integral part of the planning process, ensuring both that the plan remains relevant to its goals and objectives over time and that sustainable waste management is achieved.

In addition, monitoring and evaluation aim to improve service provision, determine if targets are met and help in identifying areas for improvements. What is more, they ensure that the progress on the implementation of the SWM Plan is on track according to the implementation program and adjustments and refinements can be made where required. Furthermore, monitoring and evaluation can provide a cost effective, sustainable and useful tool to adapt the Plan in current conditions, since in many cases planning has been based on assumptions, which need either to be verified or to be refined with time. [7, 13]

Box 10 provides an indicative list of the monitoring activities of a SWM system.

Conduction of Monitoring and Evaluation

Monitoring and evaluation of a SWM system's should provide any time the necessary information for the system's performance. This process is not easy at all since large amounts of data have to be collected and processed into useable information. [16] For this reason, they have been developed different kind of tools, in order to make easier this process. The simplest and most common monitoring tools, which are still extensively used in low-income countries, are:

- Visual observations;
- General feed-back from the work-force; or/and
- Customer complaints. [16]

Despite the immediacy of the aforementioned tools, such observations can lead to inaccurate and unquantifiable results that don't help managers to make planning decisions so as to improve the system's performance. In addition, they may provide superficial information about an applied SWM system and may miss to identify other reasons for its low performance, which might have appeared through a more detailed and formal analysis.[16] The answer to this need is **Performance Indicators (PIs)**.

It is the public Authorities that should develop and maintain certain Performance Indicators, which will help them to monitor and review the Action Plan over a period of time. It is suggested PIs to be developed in the Planning process in consultation with the stakeholders. However, in smaller administrative level (e.g municipalities), it is suggested (and whenever possible) that the collective process for the extraction of the PIs to involve, apart from the Authorities and the major stakeholders, a big part of the citizens also. [7,13]

Box 10: Indicative list of a SWM system's monitoring activities [13, 14]

General Issues

- Resource situation;
- Staff appointments, allocation of functions and training;
- Payment for services;
- Rates of generation of waste, verified by the waste information system;
- Reporting;
- Illegal dumping and littering;
- Improvement in environmental and health conditions;
- Reporting to provincial environmental departments;
- Legislation, regulations, ordinances and/or by-laws are in place;
- Complaints regarding poor waste management.

Waste prevention and minimization

- Annual reports of waste minimization programs and projects;
- Annual environmental reports on emissions to air, water and land;
- Achievement of targets for prioritized waste streams and pollutants;
- Information exchange and the establishment of waste minimization clubs.

Collection and transportation

- Annual reports on the implementation of collection and transportation services;
- Payment received for waste collection and transportation services as against the actual cost for provision of these services.

Recycling

- Annual reports on waste recycling programs and projects;
- Information exchange between stakeholders;
- Stakeholder forums coordinating new recycling activities;
- Social and environmental impacts of the implementation of new recycling initiatives.

Treatment

- Registration and licensing of waste treatment facilities;
- Auditing of waste incineration facilities by provincial authorities;
- Environmental performance and impact;
- Provision of adequate hazardous waste treatment facilities.

Disposal

- Registration and licensing of waste disposal facilities;
- Auditing of general waste disposal facilities by provincial departments;
- Environmental performance and impact;
- Provision of adequate hazardous waste disposal facilities;
- Management and control of salvaging at landfill sites.

Performance Indicators

Performance Indicators are defined as the parameters used to provide a meaningful, concise, overall picture of an organization's/ project/ program's performance. The PIs reflect long-term considerations. [7]

The key performance responding to a SWM system should provide answers to two critical questions:

1. To how effective is the SWM system applied, providing to what extent it is satisfied the need for a SWM service through the system in place and where are the requirements for improvement.

2. To how efficient is the SWM service provided, meaning if the available resources are used in the best possible way and if it can be improved their use.

Effectiveness and efficiency are closely related. Increases in efficiency lead in most scenarios to increases in effectiveness, provided resources are not cut simultaneously. [16]

Performance Indicators for SWM systems

Each SWM Plan represents a number of actions to be implemented within a timeframe. A very important step to achieve the desired outcomes is public authorities to enact an adequate monitoring process. This can be achieved by establishing the necessary set of Performance Indicators required that sets the Plan and its elements under monitoring and review. [7]

For this reason, while creating PIs for a particular SWM Plan, the public authorities should:

- Attach a PI to every function of the delivery system that has to do with an outcome that affects the citizens;
- Include a Financial PI that ensures that the delivery of that service is done in a financially efficient manner;
- Identify the data that needs to be available to quantify the PI; and
- Set-up a way to support the data that will be published.

Data Collection [7, 15]

Performance Indicators are only worth of the data that is used to calculate them. For this reason, it is important to define what information is required for each indicator, to find out what information is already available, what additional information it will need to be collected, what methods will be used to gather it, who will take the responsibility for collecting the information, and the timescale.

During monitoring it will be required to collect different types of data, including:

- numbers (for example, the number of people you have reached, the number of bins located in an area, the number of vehicles used for service provision);
- people's opinions, views and experiences (for example, people's stories about their experience on the program, photos of the area 'before and after', people's views on whether they think they have more power);
- who has benefited and who has not.

Apart from the data that have to be collected during the implementation of a SWM Plan, it is necessary before this, to determine the current situation. Establishment of the baseline is of crucial importance, since it determines the starting point of the implementation and it can be used as a first indication "on how much distance it has been travelled during the project".

It should be noted for one more time that gathering of information is a time consuming process. For this reason, it is important to identify and collect the necessary information, avoiding in that way to be overwhelmed from the large amount of data, which in most occasions may prove useless. [15]

Management Information Systems [16]

Given the above, it is more than clear that continuous monitoring and evaluation are critical elements for both the successful implementation of a SWM Plan and the successful and sustainable operation of a SWM system. In addition, it is the "quality and the quantity" of the information and data collected that specify the success of the monitoring and evaluation of a SWM system.

Despite the attention that is paid to monitoring, many public authorities fail to improve their system's performance due to lack of attention to costs, quality of services provided and accountability. The main reason of this failure is the inefficient use of the existing resources. However, if the same resources were used more efficiently, they could provide better and more comprehensive services. The only way to achieve this is with more, or better used information, through Management Information Systems (MIS).

A Management Information System (MIS) is defined, as a system in which information is collected, stored, organized, processed, utilized and disseminated. [17]

A MIS is an ongoing process, requiring a regular stream of data to be collected and fed into it. It also requires a medium for storage and processing data.

Review of a SWM Plan

The performance review of a SWM Plan can be used as a handy tool to determine the success of the Plan. The reason and the need for reviewing the plan and its implementation on a regular basis are to ensure its practicality, suitability and usability. During the review they should be assessed the appropriateness of policies, goals and strategic objectives that have been set, and whether they need to be amended and adjusted.

In case that goals or objectives have not met, it is during the review of the Plan that planners should think why they have not, and what they can learn from that.

Depending on the size of the area that the SWM Plan is applied, it is desirable to be reviewed in intervals of 1-5 years, with the principle of continual improvement to be the basic characteristic of the review. Many times, in order to help achieving the new goals and objectives that have been set by the reviewed Plan, it is useful to introduce updated and more appropriate instruments for implementing the Plan.

References

The writer encourages all readers to visit ISWA's knowledge base (http://www.iswa.org/en/525/knowledge_base.html), which contains more than a thousand articles, presentations and technical studies, many of which were used as sources for the realization of this document. Indicatively, they are proposed for studying the following:

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16. ERM for World Bank/SDC, *'Strategic Planning Guide for MSWM -User Guide to Step 7: Implementing the Strategic Plan*
17. WHO, PEPAS, 1992, "Information Management for Municipal Solid Waste Management Service", World Health Organisation, Western Pacific Region, situated in: ERM for World Bank/SDC, *'Strategic Planning Guide for MSWM -User Guide to Step 7: Implementing the Strategic Plan*
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