D-WASTE ULTIMATE REPORT

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waste management
for everyone

The Planning Challenge

A Road Map for Waste Management Planners

Collective Work by D-Waste Team

This is a step by step approach on Solid Waste Management (SWM) Planning prepared by D-Waste Team Readers will find it easy to retrieve all necessary information in order to propose effective, efficient and sustainable solutions on SWM. The report is supported by an extensive number of boxes, figures and tables helping readers to better comprehend SWM issues.

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Collective Work by D-Waste Team

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EXECUTIVE SUMMARY

The increasing complexity of waste issues around the world makes Solid Waste Management Planning an urged need. In this sense this report aims to assist everyone who wants to manage, implement, monitor and review Waste Management Plans.

More specifically the report introducing the increasing demand of effective Solid Waste Management Planning in all countries around the world and especially in countries who are in a transition phase.

The author provides the readers

- *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.*

In this sense this report is suitable 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.*

In addition, this tool can also be of interest to other involved parties /organizations such as:

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

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.

This manual should be used carefully as a guiding tool to manage, implement, monitor and review Waste Management Plans. In addition, it provides concepts, views and specific working approaches, which when combined create a road map for successful planning. However, this manual cannot substitute the difficult and hard work of specific Planning, taking into account local conditions and practices.

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.

ABBREVIATIONS

SWM – Solid Waste Management

NGOs – Non Governmental Organizations

ISWM – Integrated Sustainable Waste Management

MBT – Mechanical Biological Treatment

EU – European Union

BOO – Build, Own, Operate

WM – Waste Management

CBOs – Community Based Organizations

SEA – Strategic Environmental Assessment

C&D Waste – Construction & Demolition Waste

GDP – Gross Domestic Product

OECD – Organisation for Economic Co-operation and Development

GNP – Gross National Product

HHW – Household Hazardous Waste

PFD – Process Flow Diagram

MSWM – Municipal Solid Waste Management

MSW – Municipal Solid Waste

SMART – Specific, Measurable, Achievable, Realistic, Time-scaled

UK – United Kingdom

EC- European Commission

NA – Not Applicable

EIA – Environmental Impact Assessment

CBA – Cost Benefit Analysis

LCC – Life Cycle Costing

MFA – Material Flow Analysis

WEEE – Waste Electrical and Electronic Equipment

BMW – Biodegradable Municipal Waste

PAYT – Pay As You Throw

EPA US – Environmental Protection Agency United States

PMC – Pune Municipal Corporation

PI – Performance Indicator

SW – Solid Waste

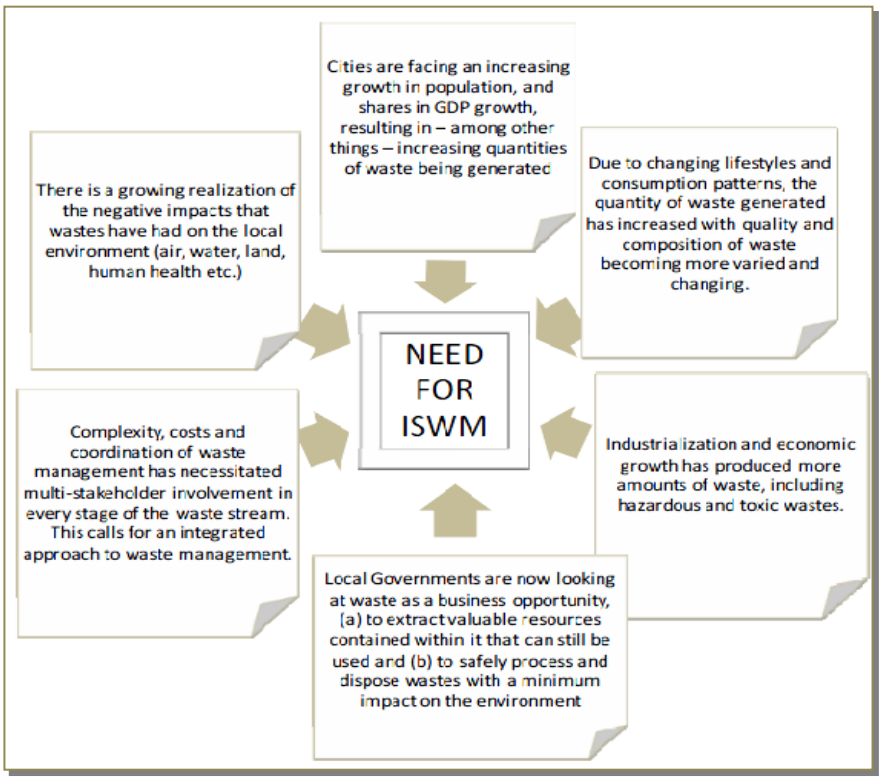
MIS – Management Information System

RMP – Risk Management Plan

1. INTRODUCTION

Worldwide, there is a growing need for sustainable and coherent solutions to municipal and industrial 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]



1.1 The Need to Draft SWM Plans in Developing Countries

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 because of either lack of funds or insufficiency in institutional capacity or for other reasons.

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 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, such as an MBT facility or an incinerator, they would have to find way to finance the projects since both works, and especially incinerators, are capital intensive. In addition, it is the operational and maintenance costs of many technologies that may be proved prohibitive for many transitional countries. There are numerous examples in several developing countries of donor-funded incinerators that have never operated, but have sat for years as a kind of dinosaur in the landscape. What is more, there are sanitary landfills built to meet EU environmental standards, which revert to being operated as an open dump because energy costs of the leachate collection system or fuel costs of operations are too high.

Other reasons for failures of high-tech approaches, when applied 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* [3]

Box 1 provides a number of examples showing the problems caused by the import of advanced technologies in developing countries without prior appropriate planning, whereas Box 2 provides a case in which authorities did not implement what the drafted SWM Plan was proposing, leading them to a great failure.

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 1 provided a characteristic example of failure, which could have been avoided just by having implemented the drafted plan. However, the authorities decided to build a facility that was not neither necessary nor appropriate for the local conditions. But why do the authorities keep on making the same mistake, as in the latter occasion?

It all has to do with capable salesmen and the "magic solutions" they can provide to their clients. **Box 2** (next) mentions useful advice concerning these "magic solutions".

Box 1: SWM failures in developing countries caused by imported advanced technologies [3]

Failure Case 1: In 1984, the Municipal Corporation of Delhi, India, built an incinerator to process 300 tones 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.

Failure Case 2: In 2003, Lucknow Municipal Corporation built an anaerobic digestion plant, as a 5MW waste-to-energy project, to process 500 to 600 tones 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.

Box 2: Beware the magic solutions [3]

It has happened to all of us. When a serious waste disposal problem occurs, there is always someone (usually a salesman) that proposes a magic solution, with no cost and substantial benefits for the municipality and the residents! In most occasions as "deus ex machina", the salesman is ready to provide an easy answer to all the difficult problems that local people face. Most of the times, the solution provided is a novel waste treatment technology, which in most cases is unproven and not commercial. The bullets following provide a number of questions that should be answered in order to examine if the proposed "magic solution" is appropriate for your specific occasion.

- Is this technology suitable for your waste (e.g. is the heating value of your waste high enough to burn without support fuel)?
- Is the technology being proposed proven elsewhere? If yes, what documentation is there to prove this (i.e. do you wish to be a 'guinea pig' for a new technology)?
- Would the contract proposed require you to meet a specified minimum tonnage of waste? Is this realistic in your current situation? Would it discourage the city's recycling efforts in the future?
- Does the technology meet international emission standards (this is essential for waste-to-energy facilities in order to ensure that air emissions, including carcinogens such as dioxins, do not pose a risk to your citizens)?
- Are the costs both realistic and affordable? Are local markets available for the heat or other products from the facility? If yes, how do you know? If not, are there plans to develop the markets? Who will finance market development?
- Can the plant be run and maintained locally, using local labour and local spare parts?
- Has a suitable site been identified? Which criteria have been used to assess suitability? Will the developer pay for full and independent environmental and social impact assessments to international standards?
- Does your country have the institutional capacity to permit and regulate facility operations?
- Have you sought independent advice, perhaps at your local university, before signing any contract?

2. INTEGRATED SOLID WASTE MANAGEMENT (ISWM)

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 linked with the view of the Planner. The view of the Planner influences the way the baseline is described and understood, the planning procedure, as well as the final outcome.

- In many cases different views provide different plans (See **Box 3**).
- The following pages present some useful approaches concerning the multi dimensional view of SWM planning.

Box 3. The most usual mistake in SWM planning

The most common mistake in SWM planning is to consider SWM as a technical issue, as something referred to public works, infrastructure and funding. This view usually results in plans full of technicalities, independent of local conditions and unrealistic.

Even more, it results in plans that ignore the importance of social interactions and the specific role of communication.

In contrast, there is a need for multi dimensional view that will address all the aspects of SWM, namely the technical, the social, the economical.

2.1 ISWM Planning

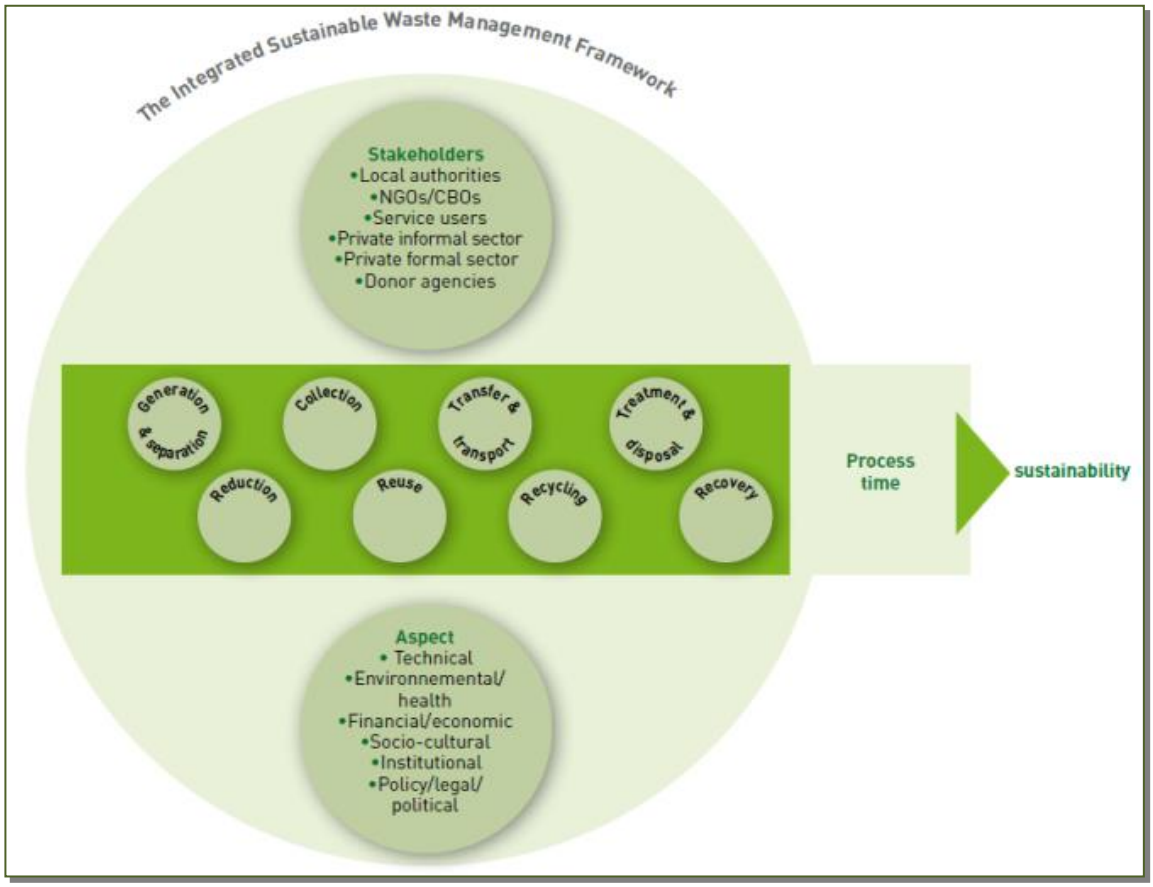
Integrated waste management planning is a dynamic tool including aspects that range from policy-making and institutional development to technical design of integrated solutions for the handling and disposal of waste. [4]

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.[5]

2.2 The Three Dimensions

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).

Figure 2. Integrated sustainable waste management [3]



2.2.1.1 1st Dimension-Stakeholders

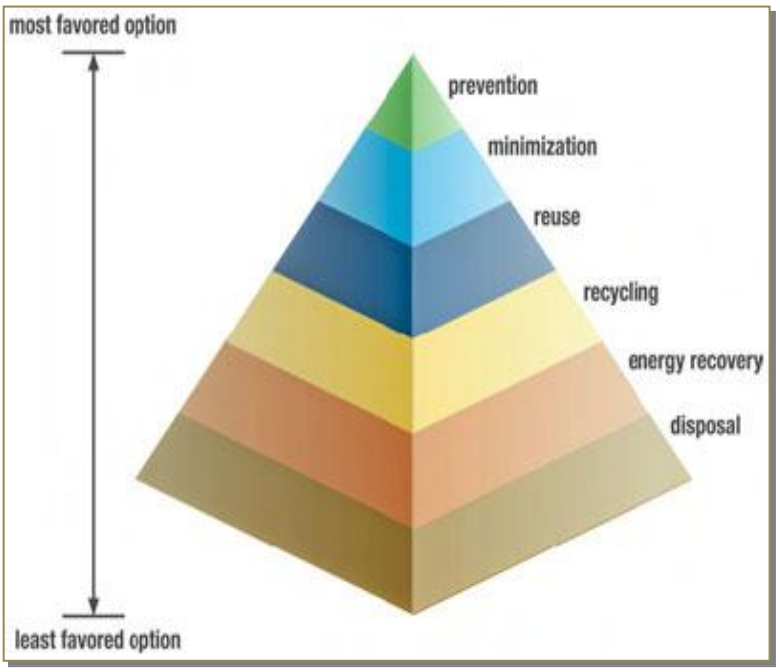
ISWM is, first and foremost, about participation of stakeholders. A stakeholder is a person or organization that has a stake, an interest in this case- waste management.

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.

2.2.1.2 2nd Dimension-Waste System Elements

Waste system elements refer to how solid waste is handled and where it ends up. Particularly this last 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 and other forms of recovery of material.

Figure 3: The SWM priorities pyramid



2.2.1.3 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. [3,5]

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 (See **Box 4**).

Box 4: Waste System Aspects

Technical aspects *concern the observable practical implementation and maintenance of all of the waste elements: what equipment and facilities are in use or planned; how they are designed; what they are designed to do; whether they work in practice; and how clean the city is on a consistent basis*

Environmental aspects focus on the effects of waste management on land, water and air; on the need for conservation of nonrenewable resources; pollution control and public health concerns.

Health aspects *have to do with the fact that WM is closely related with the protection of human health, since inappropriate, inefficient or non existing WM poses a severe danger for society*

Financial-economic aspects pertain to budgeting and cost accounting within the waste management system and in relation to the local, regional, national and international economy. Some specific issues are: privatization; cost recovery and cost reduction; the impact of environmental services on economic activities; the commodities marketplace and how the recycling infrastructures connect to it; efficiency of municipal solid waste management systems; macroeconomic dimensions of resource use and conservation; and income generation.

Socio-cultural aspects include the influence of culture on waste generation and management in the household and in businesses and institutions; the community and its involvement in waste management; the relations between groups and communities, between people of various age, sex, ethnicity and the social conditions of waste workers.

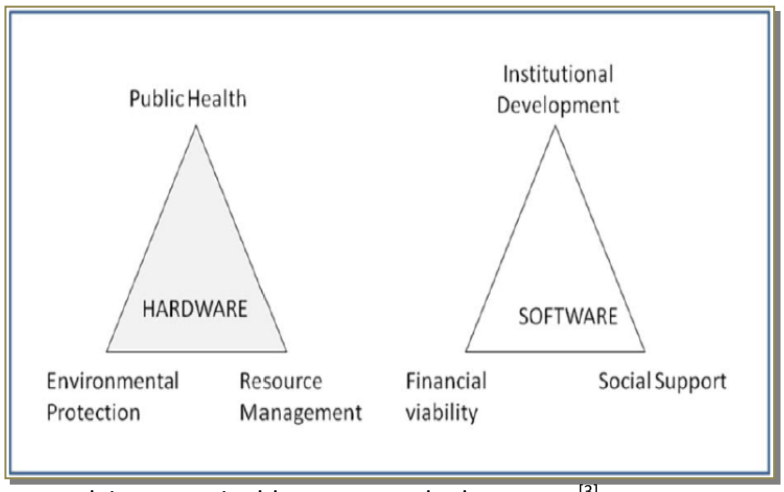
Institutional aspects relate to the political and social structures which control and implement waste management: the distribution of functions and responsibilities; the organizational structures, procedures and methods implicated; the available institutional capacities; and the actors such as the private sector who could become involved. Planning is often considered the principal activity in relation with institutional and organizational aspects.

Policy/legal/political aspects address the boundary conditions in which the waste management system exists: setting goals and priorities; determination of roles and jurisdiction; the existing or planned legal and regulatory framework; and the basic decision making processes.

[Source: http://www.greengrowth.org/partners.asp]

2.3 Hardware & 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[3]:

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.

Not all hardware collaborates well with all 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.

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. [7]

2.3.1 The Hardware of ISWM

2.3.1.1 Public Health (collection)

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

Box 5: Not all technologies are appropriate for all WM cases.

In Germany, primary collection is provided by private companies using modern equipment. On the contrary, in New Delhi primary collection is done by authorized informal sector collectors/recyclers, who deliver the waste by hand cart to a large private sector operator who provides secondary collection from communal bins. [3]

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. The example in **Box 5** is representative of the need to adopt and adapt waste collection methods that are suitable and can be easily maintained locally. [3]

2.3.1.2 Environmental Protection (waste treatment & Disposal)

Over the last 30 to 40 years, 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. [3]

2.3.1.3 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. [3]

On the other hand, many developing and transitional countries have an active informal sector and micro-enterprise recycling, reuse and repair systems, which often achieve recycling and recovery rates comparable or even better to those in the West. [3]

Box 6 analyses the influence of the Software to deliver successful recycling, reuse and waste prevention programs.

Box 6: The importance of Software elements of the ISWM in the success of recycling, reuse and waste prevention initiatives

Software elements of the ISWM (institutional development, social support and participation and financially sustainability) are becoming more and more important especially for the success of recycling, reuse and waste prevention initiatives. Those elements are the ones capable to adapt the system to the continuous change of the neighborhoods and cities within a country, especially to the poorest ones where inadequate waste management practices create serious health and environmental risks. Clearly, the Software elements control the social behavior of citizens and thus they are the most important for the success of recycling, reuse and waste prevention programs.

2.3.2 The Software of ISWM

2.3.2.1 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: [3]

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

2.3.2.2 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%. [3]

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.

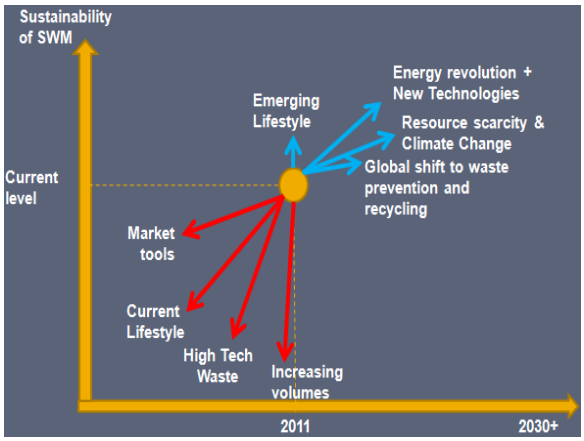
In the coming years, low- and middle-income countries will also experience an increase in the costs of SWM. This mainly relies on the fact that, in these countries, waste quantities are going to increase significantly, and more staff, equipment and facilities will be required to adequately manage them.

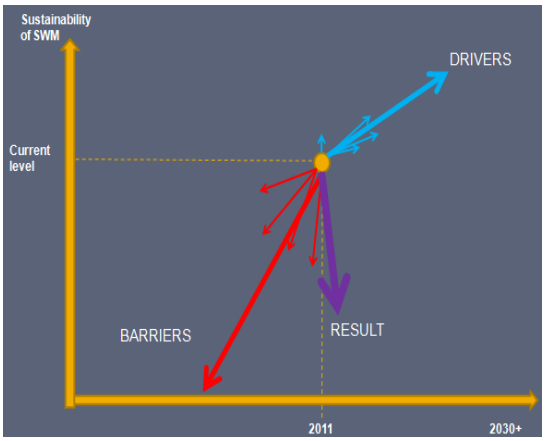
2.3.2.3 Institutional Development

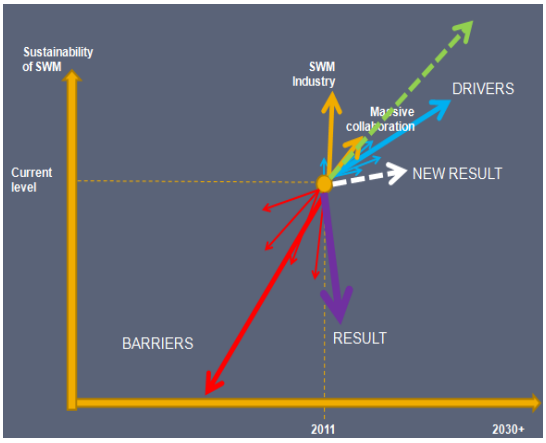
A strong and transparent institutional framework is essential to good governance in SWM. Without such a framework, the system will not function well over the long term. In addition, if waste services are designed to be effective, a city must have the capacity and the organizational structure to manage 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. [3]

2.4 Visualization of Interactions

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







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).

2.5 Beyond Traditional SWM

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 [7]. 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]

3. UNDERSTANDING SWM PLANNING PROCESS

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 protests against the procedures.

3.1 Preparing a SWM Plan

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.

3.1.1 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. [10]

→ *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. [11]

The importance of this specific step is great, because understanding strong and weak points of a SWM system's is the starting point of a program for gradual improvement, whose importance for the system's operation is analyzed in the Box 11 following.

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. For this the definition of appropriate is approached in **Box 7**.

Box 7: The appropriate SWM Plan

The appropriate SWM should:

- Build on the existing system.
- Understand the system's operation, resources, etc.
- Make SWM more sustainable in the limit of social affordability.
- Provide proposal both for physical elements and governance issues.
- Have a certain time horizon.
- Describe clearly all the demanded resources.
- Outline the needed changes in institutional and policy level.

Provide guidelines on how to pass from the planning phase to the implementation phase:

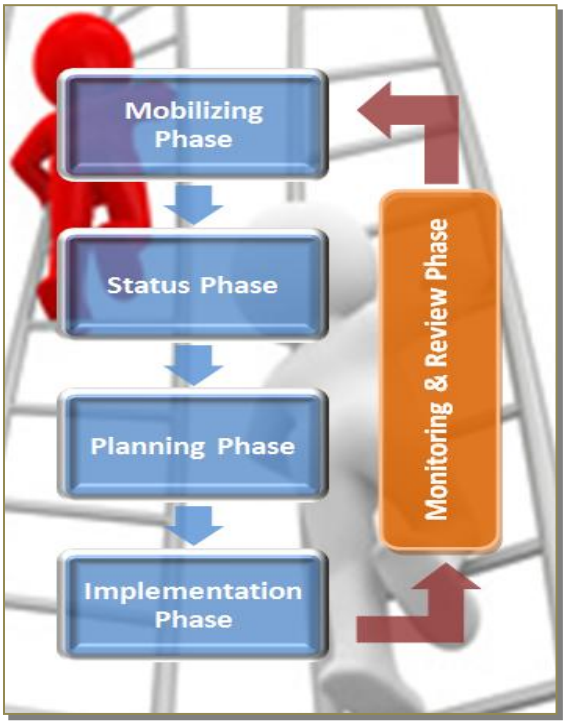
It is crucial to ensure the continuity between the planning process itself and the implementation. Therefore the planning process should provide detailed guidance on performance measures and information management systems, both of which should be used to monitor the performance of SWM systems and thus 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. [12]

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.

3.1.2 The Planning Process

Figure 6: The Planning Process



The planning process of a SWM system may be broken down in *f i v e* major phases (see Figure 6).

The Mobilizing Phase: 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.

P o l i t i c a l S u p p o r t and good will are of crucial importance for the development and the ultimate success of a SWM Plan. Therefore, the first critical step of the planning process is to make clear to the political leaders and senior decision makers that the SWM system needs improvements. In addition, this effort must be supported by National, Regional & Local Governments/Municipalities, so as to conclude to the most preferable alternatives.

S t a k e h o l d e r s' P a r t i c i p a t i o n is also an important need for applying successful SWM plans.

The planning and implementation of SWM is not primarily a technical issue, but it has to do more with the organization and the management of relationships among all the key actors and stakeholders engaged in the planning process. Prerequisite for a successful planning procedure is spread of a feeling of ownership among all the key stakeholders, including the organizations which will be responsible for the implementation of the SWM plan. The best way to achieve this is the plan to be developed through inclusive participatory planning. [13]

Stakeholders' analysis can be a useful method of identifying key stakeholders, and understanding their relative influence and involvement in SWM issues.[13] It is an analytical approach for assessing potential support or opposition to an issue among interested parties. In addition stakeholder analysis identifies the stakeholders and maps out their relative power, influence and interests in a given change effort. It identifies assumptions about each stakeholder and indicates the relative priority to be given to meeting the interests of the stakeholders, thus assessing the importance of each stakeholder to the success of the project.

The Status Phase: In this phase 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.

Box 8: 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
- Definition of the scope of the plan
- Assumptions for planning
- 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

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.

The Planning Phase: The planning phase 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.

Setting targets and objectives are a core activity of the planning phase and a prerequisite to design the Action Plan.

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.

3.1.3 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 an approach is presented in **Box 8.**

3.2 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*

3.2.1 The Scope of a Master Plan

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

- *To define the types and the amounts of waste in the studied geographical areas;*
- *To identify and prioritize the needs of the current SWM system;*
- *To set the specific objectives of the SWM Plan, as they are provided either by legislation or by specific local priorities and conditions.*

3.2.2 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.

3.3 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.[14,15,16]

The stakeholders in a Waste Management Planning Process can play a very important role (See **Box 9**) 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. [15]

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". [22,23] 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). [5,24,25]

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.[2] 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.[26]

Box 9: Stakeholders in waste management and some of the roles they can play

The stakeholders active in waste management are manifold and may include local authorities, provincial and national governments, formal private waste collection companies (large-scale enterprises and registered small-scale enterprises), business associations, compost and bio-gas facility operators, farmers, latrine emptying service providers, waste-pickers, informal waste collectors and buyers, materials dealers, recyclers, service users (residents, commercial establishments, etc.), NGOS, CBOS, religious institutions, universities, banks, etc. [17]

Moreover, involvement of stakeholders can take several forms. For example the involvement of local communities of developing countries in planning and implementation does not mean that residents are used as cheap labor. They can play a range of roles, such as those of:[5,18,19,20,21]

- *Residents - placing waste outside for collection, separating it at source,*
- *Community managers - participating in the design of a waste service, recruitment of*
- *Workers - setting rates for user charges,*
- *Citizens - pressuring municipal authorities so that services are being offered,*
- *Community members - participating in clean-ups,*
- *Clients - paying for waste management services,*
- *"Watchdogs" - monitoring and supervising the operation of services.*
- *Dealers, who buy, sort and sell materials.*
- *Wholesalers - usually specialized in one material, who aggregate materials and compress them for more efficient shipment and who sell them to industries.*
- *Recycling enterprises - processing recyclables into intermediate industrial feed stocks,*
- *Government Departments responsible for one or more streams,*
- *Regulators – e.g. Environmental Protection Bureau, and many others.*

3.3.1 The Role of Informal Sector

Informal sector is one of the most important stakeholders in Latin America and generally in developing countries. This subsection aims to outline the role of informal sector in SWM and in planning procedures. However, its role and its actions will be further analyzed in the Status and the Planning parts.

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. [27, 28]

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. [28]

Independently from the name they are given or how they would like to be called, the informal collection sector can be divided into five types of activities and roles: [29]

- *Street pickers collect materials that have already been discarded by households. In some cases street pickers extract materials from household waste set-outs, breaking bags, and/or picking up re-usables or materials waiting for formal collection. In other cases street pickers remove materials from dumpsters or community containers or secondary collection sites.*
- *Itinerant waste buyers (IWBs) move along a route, and collect recyclables from households (or businesses).*
- *Dump pickers work and often also live on the landfill or dumpsite, and sort through the waste as it is disposed there.*
- *Truck pickers are informal members of formal sector waste collection crews, and ride with the trucks. They inspect the waste as it is loaded onto the truck, and separate out valuable items for sale. Sometimes truck pickers are actually paid members of the formal sector work crew, but they may also be outsiders who have gained the right to work along with this crew.*
- *Informal Service Providers offer unregistered or unpermitted waste collection service. This type of collection service may include mixed waste collection too, and it is a common phenomenon for areas with lack of infrastructure.*

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.[30] 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 [28] , 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. [27, 28] **Box 10** provides some statistics about the number of informal sector around the world.

Box 10: Waste pickers in numbers around the globe [31]

There are millions of waste pickers worldwide, but little reliable socio-economic or statistical information exists. A 1988 World Bank study estimated that in certain countries waste pickers comprised 1-2 per cent of the population. A more recent study in India estimated waste pickers in that country numbered 1.5 million people, primarily women and those from socially marginalized groups (Chaturvedi 2010). There are an estimated 18,000 recicladores in Bogota, Colombia; 15,000 clasificadores in Montevideo, Uruguay; and 9,000 cartoneros in Buenos Aires, Argentina. In Brazil, the only nation that systematically captures and reports official statistical data on waste pickers, they are estimated to be 229,568 [32].

3.3.2 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.

3.3.3 Environmental Impacts of a 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. More indicators are described in **Box 11** that follows.

Box 11: European Strategic Environmental Assessment (SEA) Directive

Potential consequences of unsustainable SWM may be identified to include the following indicators:

- Long term effects of pollutants entering the surface or groundwater resources, air and soil affecting the fitness for use, and availability of the resource for use. More specifically:
  - *Pollution of watercourses and groundwater by leaching of pollutants from waste inappropriately disposed of, or where waste management service provision is inadequate, particularly evident for dense urban informal settlements.*
  - *Pollution of watercourses and groundwater by leaching of pollutants from waste residue deposits, particularly mine and power station waste dumps.*
  - *Air pollution by dust releases from particularly mine residue deposits, but also general and hazardous waste sites (methane gas production) and waste incinerators.*
  - *Nuisance from odours of waste degradation in landfill sites, waste disfiguring the environment especially plastic bags, and littering where waste service provision is limited.*
  - *Reduced biological diversity in the areas of waste management operations, as a result of land disturbance or effects of emissions and discharges from the waste facilities.*
- Increased waste management costs to provide safe and effective long-term disposal sites for increasing waste loads, including treatment of wastes to render them less environmentally available, and effective closure and rehabilitation of historically inadequate waste sites.
- Increased pressures through the negative societal impacts of inadequate service provision fostering illegal waste dumping, littering and abuse of open spaces.
- Increased health and environmental risks associated with inadequate waste collection and disposal services, and informal salvaging on landfill sites.
- Poverty encourages salvaging on waste sites for recyclables, refuge materials, fuel and food.
- Reduced recreational value of land and water resources by inadequate waste services.
- Reduced tourism and investment by negative impressions of widespread littering, illegal waste dumping and perceived ineffective management of general and hazardous waste.
- Environmental risks as many waste sites which do not meet the Minimum Environmental Requirements, requiring upgrading to the specifications, or closure and rehabilitation.
- Establishment of industries on smallholdings contributes to illegal dumping of waste.

[Source:http://www.environment.gov.za/soer/reports/gauteng/Chapter%209%20Waste%20Management.pdf]

In this sense Europe has enforced a relative Strategic Environmental Assessment (SEA) Directive (2001) that forces Member States to carry out a screening procedure to determine whether the plans/programmes are likely to have significant environmental effects. If there are significant effects, an SEA is needed (See **Box 12**).

Box 12: European Strategic Environmental Assessment (SEA) Directive

The Strategic Environmental Assessment Directive applies to a wide range of **public** plans and programmes (e.g. on land use, transport, energy, waste, agriculture, etc) and does not refer to policies. It is in force since 2001 and should have been transposed by July 2004.

Plans and programmes in the sense of the SEA Directive must be prepared or adopted by an **authority** (at national, regional or local level) and be **required** by legislative, regulatory or administrative provisions.

An SEA is **mandatory** for plans/programmes which:

- *are prepared for agriculture, forestry, fisheries, energy, industry, transport, waste/ water management, telecommunications, tourism, town & country planning or land use and which **set the framework** for future development consent of projects listed in the EIA Directive.*

or

- *have been determined to require an assessment under the Habitats Directive.*

The SEA procedure can be summarized as follows: an environmental report is prepared in which the likely significant effects on the environment and the reasonable alternatives of the proposed plan or programme are identified. The public and the environmental authorities are informed and consulted on the draft plan or programme and the environmental report prepared. As regards plans and programmes which are likely to have significant effects on the environment in another Member State, the Member State in whose territory the plan or programme is being prepared must consult the other Member State(s). On this issue the SEA Directive follows the general approach taken by the SEA Protocol to the UN ECE Convention on Environmental Impact Assessment in a Transboundary Context.

The environmental report and the results of the consultations are taken into account before adoption. Once the plan or programme is adopted, the environmental authorities and the public are informed and relevant information is made available to them. In order to identify unforeseen adverse effects at an early stage, significant environmental effects of the plan or programme are to be monitored.

For more information please advice the following internet link:

http://ec.europa.eu/environment/eia/sea-legalcontext.htm

3.3.4 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 may vary according to its urgency. However, it is estimated that the entire Planning process takes around 18 months. [26]

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

- *Environmental Plans,*
- *Energy Plans,*
- *Health Plans,*
- *Spatial Plans*

4. DEFINING THE BASE LINE

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.

Assessing the present patterns of waste management provides excess information of where the materials are generated, where they are manufactured into products, where they are sold and consumed and by whom, if the waste materials are recovered and where they are disposed. The analysis when complete offers a comprehensive picture of materials flow.

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 coorperation 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 (See also **Box 13**).

Box 13: The advantages and disadvantages of collecting baseline data [33]

Advantages

- ✓ Only by having a deep understanding of the current settlement conditions in your area, you are able to improve the existing SWM system
- ✓ Collecting background information helps to determine the requirements for an adequate SWM system from both technical and user perspectives
- ✓ The process is designed to be strongly participatory and therefore guarantees the acceptance and support of the local community

Disadvantages

- × The process can be quite time-consuming and needs resources in order to fulfill the required steps

4.1 *Collecting 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.

Box 14: Background Information in SWM Plans

Geographic Boundaries of the Plan Area
- Key SWM geographic data

Socio-economic Background
- Population size and trends
- Demographic statistics (migration rates, density, geographic distribution, etc)
- Income profile
- Urban employment by sector
- Economic development
- Customs and culture

Housing
- Dwelling ownership
- Dwelling unit profile (occupants, size, facilities, access to facilities, etc)
- Low-income dwelling unit profile (growth rate, density, access to facilities, *etc)*

Political Profile
- Administrative system
- Key authority designation
- Key planning initiatives (national, regional, local)
- Key city objectives

Natural Environment
- Ecosystem(s) description (include region, not just metropolitan area, also any *areas of particular sensitivity)*
- *Climate (rainfall, temperature, dispersion conditions)*
- *Water table and resource supply (inputs and outputs)*
- *Topography*
- *Environmental hazards (eg, monsoon, landslides, seismic and volcanic activity)*
- *Environmental issues (eg, traffic, air quality and water quality)*

Land Use
- Urban land use by category
- Land ownership and registration
- Land use regulation
- Land use by suitability

Health
- *Basic statistics*
- *Principal diseases and rate*
- *Geographic and social indicators*

In addition, not all the collected data are of the same importance in the planning process. There are data of medium importance (e.g health statistics) and data of great importance (e.g population size).

In addition, not all the collected data are of the same importance in the planning process. There are data of medium importance (e.g health statistics) and data of great importance (e.g population size).

Box 14 presents an overview of background data and information required in the SWM planning process. It might seem that the load of information is too wide; however, 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. [34]

The more background information provided the better, and where there is a group of decision-makers a process of gathering and discussing contextual information will be extremely valuable in establishing an understanding of the indicators and preparing for the process of developing ISWM plan. This learning process can be very valuable in helping decision-makers appreciate the

costs and benefits associated with the choice they are making, and leads to more informed and justifiable decisions.

4.1.1 Data Collection

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.

As far as information for waste is concerned, some countries use data from industrial or public associations, and from the monitoring of waste products, in addition to data from other sources. The option is mainly used for data on the recycling, recovery and export of green list waste.

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:

4.1.1.1 Administrative Records

Data can be found in:

- *Feasibility/planning studies*
- *Application/registration forms*
- *Supervision reports*
- *Meeting reports*
- *Community and agency meeting minutes*
- *Progress reports*
- *Community organization records*
- *Notices in offices, community centers, etc.*

4.1.1.2 Secondary Data

- *Census*
- *Surveys*
- *Ministry/Agency reports/records*
- *Special studies by NGOs, donors*
- *University studies*
- *Mass media (newspapers, radio, TV)*

'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:

4.1.1.3 Observation

Observation entails the systematic noting and recording of events, behaviors, and artifacts (objects) in the social setting chosen for study.

The observational record is frequently referred to as *field notes*—detailed, nonjudgmental, concrete descriptions of what has been observed.

Observation can range from a highly structured, detailed notation of behavior structured by checklists to a more holistic description of events and behavior.

Observation is a fundamental and highly important method in all qualitative inquiry. It is used to discover complex interactions in natural social settings. [35]

4.1.1.4 Interviews

Valuable information can be obtained through interviews with key stakeholders and especially the waste producers.

However, interviews shall not be limited to just officials and high status people. Everyone can be a key informant on their own situation e.g: employees of municipal social assistance offices, informal sector in SWM, etc.

Types of interviews that can be used are:

- *Personal Interviews*
- *Group Interviews*
- *Phone Interviews*

4.1.1.5 Surveys

Surveys are used to collect data and information. The collection of data and information are carried out by questionnaires which are sent to either enterprises or households, as being waste generators or other main key stakeholders and organizations.

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.).

Box15: Pitfalls and success factors in the data collection process [37]

Getting stuck in data collection – Collecting an endless mass of data is time consuming and often unnecessary. The basic situation and trends often become sufficiently clear without the need to achieve '100% information coverage'.

Meeting resistance from sources of information – Resistance to the provision of information can come from within or outside the local administration and is typical where people are unaware of the reasons behind the collection of information. Involving 'owners of knowledge' actively in the SWM process can help to overcome resistance.

Poor quality information – The collection of information is in vain if it is not accurate enough for use. All collected data should be validated and a wide range of sources used when gathering information.

Preventing access to gathered information – Once the information has been collected it should not be "hidden". Everyone should have access including institutions and other government departments as well as the general public.

Other Constraints – (Budget constraints, time constraints, political constraints, etc.)

Waste producers are experts – The local community is a valuable source of information and their knowledge should be fully utilized. Waste producers are as important as waste specialists or consultants when it comes to providing information about SWM issues.

[36]

Data collection process might be successful or face constrains that are likely to occur (See **Box 15**)

4.1.2 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. [38]

4.1.3 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).

Box 16: Steps in sampling process [39]

Step 1: Define (profile) your target population – decide which factors are important.
Step 2: Decide how to obtain a sample that is reflective of this profile (your sampling strategy).
Step 3: Decide how precise you want the results to be – the required sample size will depend on this.
Step 4: Design your sampling in a way which reduces bias.
Step 5: Collect the data.
Step 6: Weight your data to match your target population if necessary.

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. **Box 16** summarizes the steps in the sampling process.

4.2 Defining Current Situation

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*

4.2.1 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 tourism*
- *Form the basis for projected waste volumes and types;*
- *Evaluate of financial recovery*
- *Assess the requirement for waste management services and infrastructure.*

Base Population: The quantification of the base population is necessary in order to calculate population growth in the projections section. This can be obtained from the most recent censuses figures for the area under consideration.

4.2.2 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. [37]

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. [37]

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

4.2.3 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.* [40]

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.

4.2.4 Legal Instruments

National Laws, Acts, and Regulations can provide the necessary information on the provisions and objectives that have been set in National or local level. It is essential that waste Laws shall be taken in mind when preparing a SWM plan.

In addition distinction between national level framework including legislation and policies, and local by-laws and regulations is necessary.

A possible range of laws at national level that might exist are:

- *Public Health/Waste Collection Legislation*
- *Waste Disposal (or more general Environmental Protection Legislation*
- *Special Laws Related to Recycling*
- *Codes of Practice and Statutory Guidance*
- *Physical Planning Laws*
- *Legal Framework for Privatization*

4.2.5 Economic Instruments

Financial disincentives (in the form of charges, levy, fine and penalty for waste generators) and Economic incentives (such as subsidies or payback for recycling) could be common economic instruments. Some examples could be: [40]

- *Levy on use of fresh resources in industrial production*
- *Subsidies for recycling in industrial production*
- *Volume-based solid waste fee on non-recyclable waste*
- *Penalties on hazardous waste*
- *Subsidies for resource recovery, including power-generation at landfill*

4.2.6 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: [41]

- *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*

However, with the increasing rate of solid waste from diversified, unconventional sources (like industries and laboratories respectively), and awareness and regulations (for recycling and recovery, hazardous waste management and source reduction by intervening at production and consumption level), various institutions got involved into one or more aspects of solid waste management chain.

This transition from public to private institutions for undertaking various public utilities and services demanded governments to establish strong regulatory institutions to make sure that the service providers deliver effective and efficient services. There may be more than one institution involved at the same level or for the same type of activity, for example, informal and formal sector for recycling or public and private sector for collection and transportation of municipal waste. [40]

4.2.7 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.[42]

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.

4.2.7.1 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. [18]

Box 17: Examples of Waste sources

- *Households,*
- *Industries,*
- *Enterprises,*
- *Institutions,*
- *Construction and demolition sites*

What is more, source specific quantification and characterization of wastes can be proved very helpful in predicting the waste quantity from various waste generating sources in an area and this can be used as a basis for the planning of the system. This will also enable in saving of time, manpower, and financial inputs required to be spent for estimating the waste quantity for the greater area. [43] **Box 17** presents examples of waste sources.

4.2.7.2 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. [44, 18] **Box 18** presents indicatively and not restricted examples of waste streams. [18, 2]

Box 18: 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.

4.2.7.3 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. [43]

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. **Box 19** presents the main steps required for estimating waste quantities.

Box 19: Main steps required for estimating waste quantities

Step 1: collect data (records, demographics, social etc.)

Step 2: create a profile of waste generation (per type of population and area or per income etc.) Link type of areas and population with a special waste production (Kg/inh/year or per day)

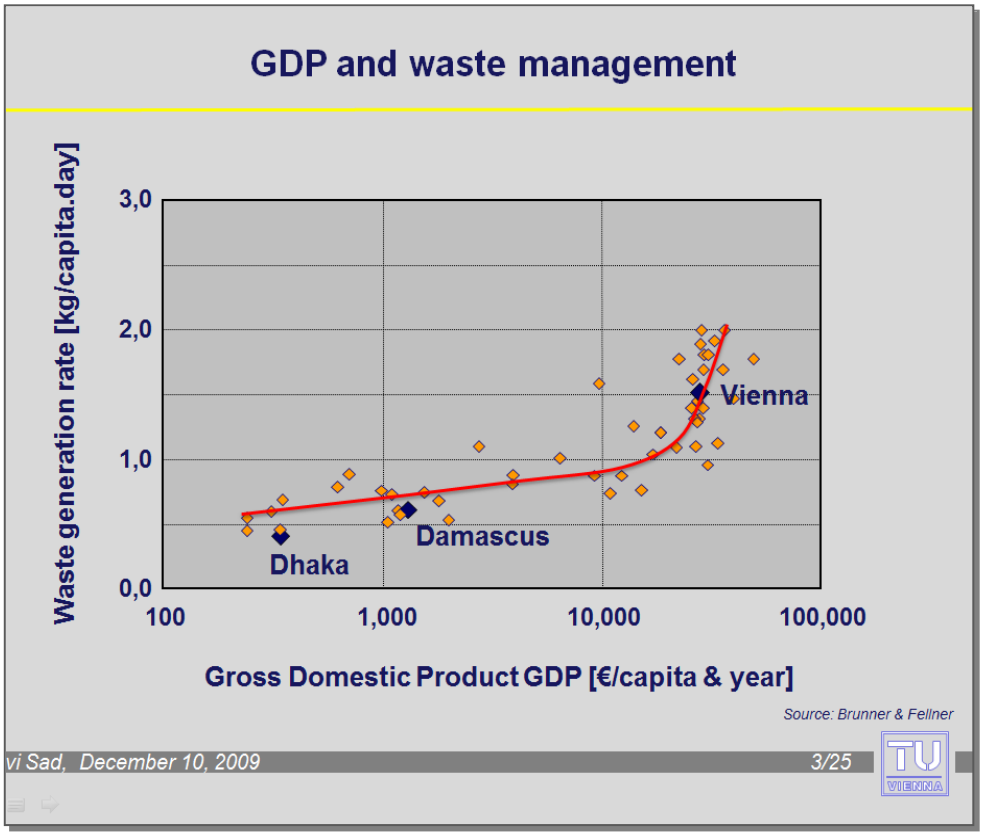
Step 3: Calibration of the profile. If there are waste load records (from landfills, recycling activities etc.) compare the profiled waste generation (tons/ year) with the data resulted from the records – make any necessary adjustments and explain possible gaps and differences

Step 4: After the Calibration step, create a model to estimate expected quantities generated for the next 10-15 years. This model has to take into account the overall expectations of the area under discussion e.g. economic and residential development, migration issues etc. It is better to work with ranges rather than specific figures. As an example it is better to work with a special waste production in a range between 0,2 - 0,4 tons generated per inhabitant per year than to work with 0,3 tons/inh/year.

Step 5: Justify the waste generated in crucial years like e.g. the next year, the first year when the planned infrastructure will be available etc.

Please notice that waste generation rates are closely related with GDP/capita. An example is given at Figure 7.

Figure 7: GDP per capita vs. Waste generation per capita [45]



In high-income countries, an urban population of 0.3 billion generates approximately 0.24 million tonnes of MSW (0.8 kg per capita per day), while in low-income countries around the same amount (0.26 million tonnes per day) is generated by 1.3 billion people (0.2 kg per capita per day), a quarter of the level in high-income countries. In addition, waste generation might varies with a high 5.3 kg/day for OECD countries to less than 0.5 kg/day in developing countries.

More data is presented in Table 1.

Table 1: Domestic waste collected and GDP in cities around the world [46]

Country	Kg/inhabitant	GNP/inhabitant for 2007 ($)
USA	730	45,593
Australia	680	42,522
UE 15	577	28,100
Turkey	480	6,547
Japan	434	34,022
New Zealand	400	29,697
Canada (domestic)	382	42,738
UE NEM	375	20,153
South Korea	361	19,624
Russia	346	8,611
Taiwan	339	16,274
Brazil	337	6,841
Mexico	332	8,426
Singapore (Domestic)	325	34,152
Chile	318	9,697
Indonesia	255	1,824
Morocco (domestic)	250	2,367
Thailand	237	3,399
Ukraine	235	2,829
China	230	2,459
Venezuela	220	8,251
Argentine	209	6,309
Colombia	199	3,614
India (urban)	164	964
Vietnam (urban)	146	808
South Africa	144	5,723
Pakistan	127	908

4.2.7.4 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.

Waste density and waste moisture are two parameters of major interest. The first one is used to determine correlations between waste volume and waste weight, influencing more the collection and the transfer methods of wastes, whereas the second is related to the density of wastes and is critical parameter for the chosen treatment method and especially incineration.

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

The problem is that a lot of times composition data is simply not available and waste composition studies are either expensive and / or time consuming to be implemented. Although

it is strongly suggested to implement waste composition studies, some global trends are presented in Table 2 in order to support an approach to waste compositions.

For example, the large percentages of sand and grit in Bamako, and 'other' in Lusaka, make these cities exceptions to the generally high percentage of organics. The differences in the way composition is analyzed are also quite noticeable.

Table 2: Waste composition in different cities around the world [46]

Country	Paper (%)	Glass (%)	Metal (%)	Plastic (%)	Organic (%)	Other (%)	Household hazardous waste (HHW) (%)	Residue (%)	Total (%)
Adelaide, Australia	7	5	5	5	26	52	0	0	100
Bamako, Mali	4	1	4	2	21	52	0	0	83
Belo Horizonte, Brazil	10	3	2	11	66	4	0	5	100
Bengaluru, India	8	2	0	7	72	9	1	0	100
Canece, Peru	6	2	2	9	70	11	0	0	100
Curepipe. Republic of Mauritius	23	2	4	16	48	7	0	0	100
Delhi, Inbdia	7	1	0	10	81	0	0	0	100
Dhaka, Bangladesh	9	0	0	4	74	13	0	0	99
Ghorahi, Nepal	6	2	0	5	79	7	0	0	99
Kunming, China	4	2	1	7	58	26	0	0	98
Lusaka, Zambia	3	2	1	7	39	48	0	0	100
Managua, Nicaragua	9	1	1	8	74	1	0	5	100
Moshi, Tanzania	9	3	2	9	65	5	0	7	100
Nairobi, Kenya	6	2	1	12	65	15	0	0	100
Quezon City, Philippines	13	4	4	16	50	12	0	0	100
Rotterdam, Netherlands	27	8	3	17	26	19	3	0	100
San Francisco, USA	24	3	4	11	34	21	0	0	100
Sousse, Tunisia	9	3	2	9	65	11	0	1	100
Tompkins Country, USA	36	6	8	11	29	11	0	0	100
Varna, Bulgaria	13	15	10	15	24	23	0	1	100
Average	12	3	3	10	53	17	0	1	100
Median	9	2	2	9	61	12	0	0	100

4.2.8 Current SWM Practices & Infrastructure

4.2.8.1 Waste Collection & Transport

Box 20: Example of the contents of a detail waste collection assessment report at local level

In local level a more detail assessment shall be conducted including:

- *Human resources involved*
- *Equipment for the specific type of service*
- *Equipment maintenance*
- *Organizational structure of service provider*
- *Costs and revenues*
- *Distance to point of transfer (if any)*
- *Distance to disposal site*
- *Collecting routing*
- *Frequency of collection at the transfer station*
- *Transfer station equipment (type) and hygiene*
- *Personnel management, health and safety*
- *Communication of service user, service user with municipality, and service provider with municipality*

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. [18]

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 (See example in **Box 20**).

It is essential to assess the following baseline service level for both collection and transportation:

- *Number and location of collection points and collection routes;*
- *Type of service*
- *Communal collection*
- *Block collection*
- *Kerbside collection*
- *Door-to –door collection*
- *Percentage of households covered by an existing collection system, as well as the percentage unserviced;*
- *Frequency of collection*
- *Inventory of collection and transportation vehicles*
- *Quantities and type of waste collected and transported*
- *Names of waste transportation companies; a register of hazardous waste transportation companies exists that is being extended to general waste transports;*

Most often two steps in solid waste collection are observed. A 'primary collection' involving waste collection from households and its transport to a transfer site, and then a secondary collection system which collects from the transfer site and transports the waste to a final disposal site.

4.2.8.2 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*

4.2.8.3 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.*

In order to prepare a detailed report of the current facilities the following key figures shall at least be described:

- *The number and types of existing facilities;*
- *The physical and operational characteristics of the waste management facilities (waste amount treated annually, maximum capacity, expected lifetime of the plants, treatment costs); More detailed information that can be obtained is presented in* ***Box 21.***
- *The mode of transport and average transport distances between the source of waste and the waste management facilities, and where appropriate, between waste management facilities and onward processing of recyclables;*
- *The type of route used to transport waste (eg urban or rural roads, or motorways).*

Box21: Detailed Information to be collected for each treatment facility

- *Name of treatment facility*
- *Area, region, province or industry serviced*
- *Type of treatment*
- *Geographic location of the facility*
- *Year of construction*
- *Capacity of each facility*
- *Daily/weekly/annual throughput for facility*
- *Hours of operation (per day, week, year)*
- *Flowchart for input and output of waste from treatment process*
- *Production of recoverable material from facility*
- *Equipment for cleaning of gaseous and liquid emissions*
- *Environmental monitoring program for facility*
- *Number of persons employed*
- *Environmental impacts due to operation of the treatment facility*
- *License/permit/registration certificate.*

The registration may be done through questionnaires or visits to the plants.

In addition to the above mentioned there is a need to evaluate the collected data and measure the performance of the current facilities. Potential indicators of the performance of the plants might be the density- expressed either in numbers of households per facility, or

average area served by each facility-provides a rough measure of the level of access afforded by these facilities.

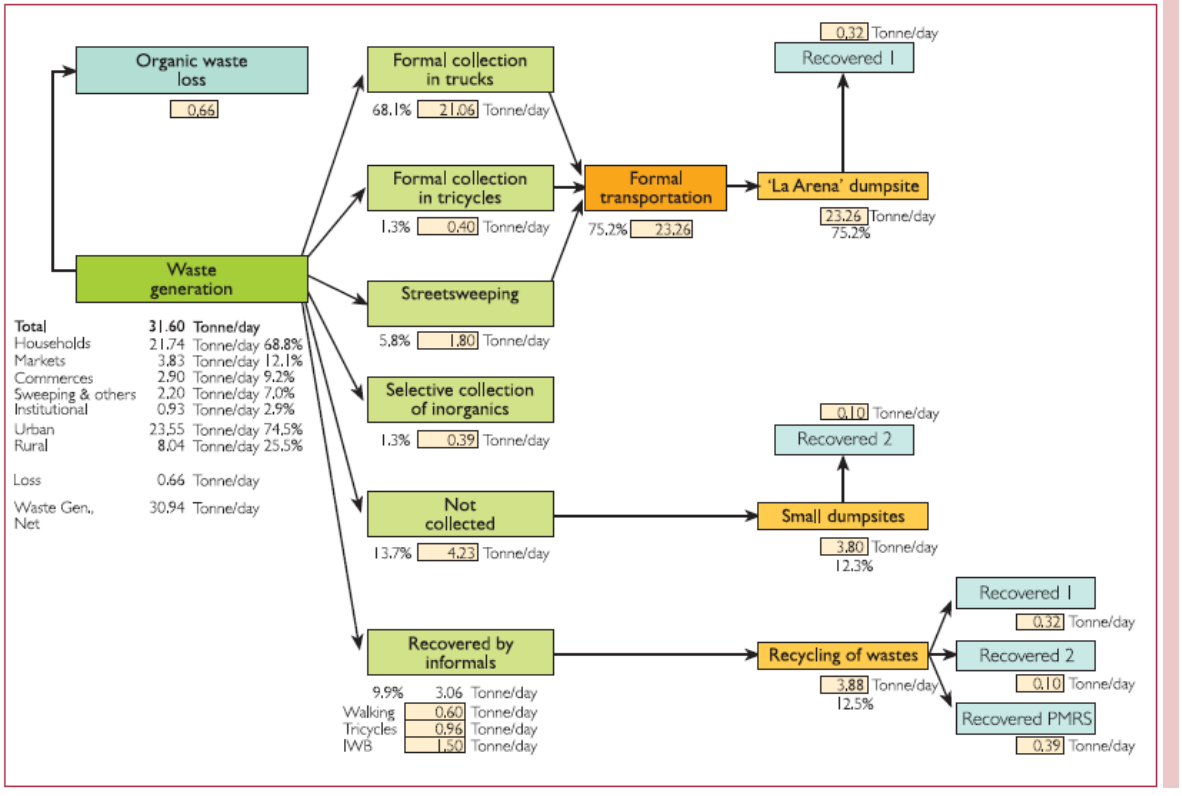
4.2.8.4 Waste Disposal

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.*

Figure 8 summarizes the output of a typical status inventory for waste management. This type of graph is known as Process Flow Diagram (PFD) and it is considered as the most useful way to visualize and understand the waste management status of an area. If the planners manage to create a successful graph like this, then the baseline for any decision has been established in the best way.

Figure 8: Process flow diagram for Canete, Peru [46]



4.2.9 Economics & Financing of the Current SWM System

4.2.9.1 Economics

Waste Management economics concern a great 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.

According to the above mentioned there is a need to establish the investment and operating costs of the current collection, transport, treatment, and disposal systems. These often include costs for:

- *Personnel (wages, salaries)*
- *Transport (fuel, repair)*
- *Operating and maintenance*
- *Administration and staff training*
- *Environmental impact abatement and penalties*
- *Interest and depreciation*

4.2.9.2 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.*

4.3 Evaluating 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

4.4 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. **Box 22** provides a useful tip to Planners.

Box 22: Useful tip about stakeholders

Identification of stakeholders during the draft of the baseline study aims primarily to create a mind model regarding the decision – making and the influences expected, but also to collect the appropriate data to assess the baseline. For this reason, it is advisable to form a multi-disciplinary team with representatives from the major stakeholders, which will be charged with collecting the needed data, ensuring the same time that all aspects of the waste management system have been fully covered. By assuring the involvement of stakeholders, the credibility of the assessment's results is increased and a later obstruction from stakeholders is avoided.

4.4.1 Defining 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.

A well functioned tool of performing hardware and software evaluations is the use of detailed and comprehensive tables as these provided in Tables 3 and 4.

Both tables need to provide information on the weak and strong points of each of the aspects constituting then main parts of the hardware and software. Financial, social and Institutional

aspects of the Software and environmental, health and Resource/Recovery aspects of the Hardware shall thoroughly be examined.

Finally the results of the evaluation will form the baseline of indicating the necessary improvements that shall be performed and included in the planning part.

According to the above mentioned the role of the evaluation tables is to:

- *organize the data collected in the previous tasks*
- *assess the existing situation in a quick and easy way*
- *Identify problematic areas and strong points of the current SWM*
- *Indicate the necessary improvements that shall be included in the planning part*

Table 3: Software evaluation table

SOFTWARE	Example of issues under examination	Strong points ✓	Weak points ✖
Financial Aspects	Level of subsidy & economic incentives		
	Cost reduction procedures/incentives		
	User charge system (level of charge, collection mechanism, collection efficiency)		
	Financing accounting and cost recovery		
	Other		
Social Aspects	Social condition of waste workers		
	Orientation of SWM service to service needs and demands of population		
	Public awareness of solid waste problems and priorities		
	Extent of community participation in waste collection services		
	Socio-economic issues for waste-pickers		
Institutional Aspects	Distribution of functions, responsibilities and authority		
	Management/organizational structures		
	Interactions between departments, between different municipalities etc.		
	Institutional Capacities		
	Informal and private sector involvement		
	Personnel administration		

Table 4: Hardware evaluation table

HARDWARE	Example of issues under examination	Strong points ✓	Weak points ✖
Environmental Aspects	Site management & facilities performance		
	Environmental conditions		
	Other		
Health Aspects	Working conditions (safety/sanitation/work load)		
	Public health		
	Other		
Resource/Recovery Aspects	Realistic targets		
	Source separation scavenging		
	Market for recovered resources		
	Public awareness		
	Other		

4.4.2 Creating 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.

Box 23: 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

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.

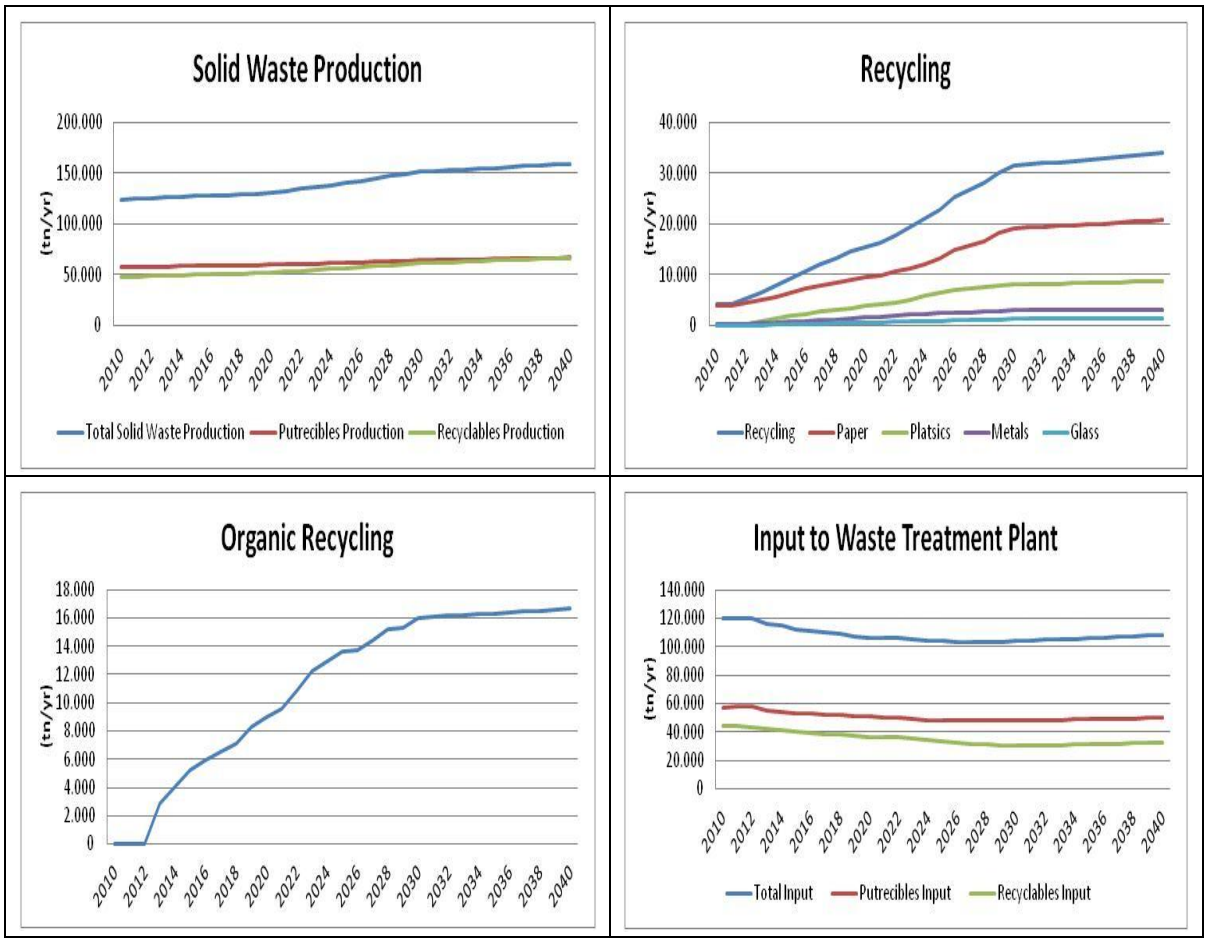
Box 23 mentions indicative parameters, that should be taken into consideration when conducting waste data projections, whereas **Box 24** two examples of relationship between factors and waste data.

Typical waste flow models are presented below in the form of excel graphs are summarized in Figure 9.

Box 24: Examples of Relationship between factors and waste data

- Reported total waste generation in OECD Europe increased by nearly 10% between 1990 and 1995, while economic growth was about 6.5 % in constant prices, providing that for each per cent of economic growth the corresponding increase in waste production is around 1.6%.
- There is an observed decline in waste from production in some countries, probably because of better use of cleaner technology. However, this has not been sufficient to neutralize the increase in total waste amounts due to the growth in the quantity of goods produced and consumed.

Figure 9: Typical waste flow models [47]



4.4.3 Defining 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.

4.4.3.1 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.

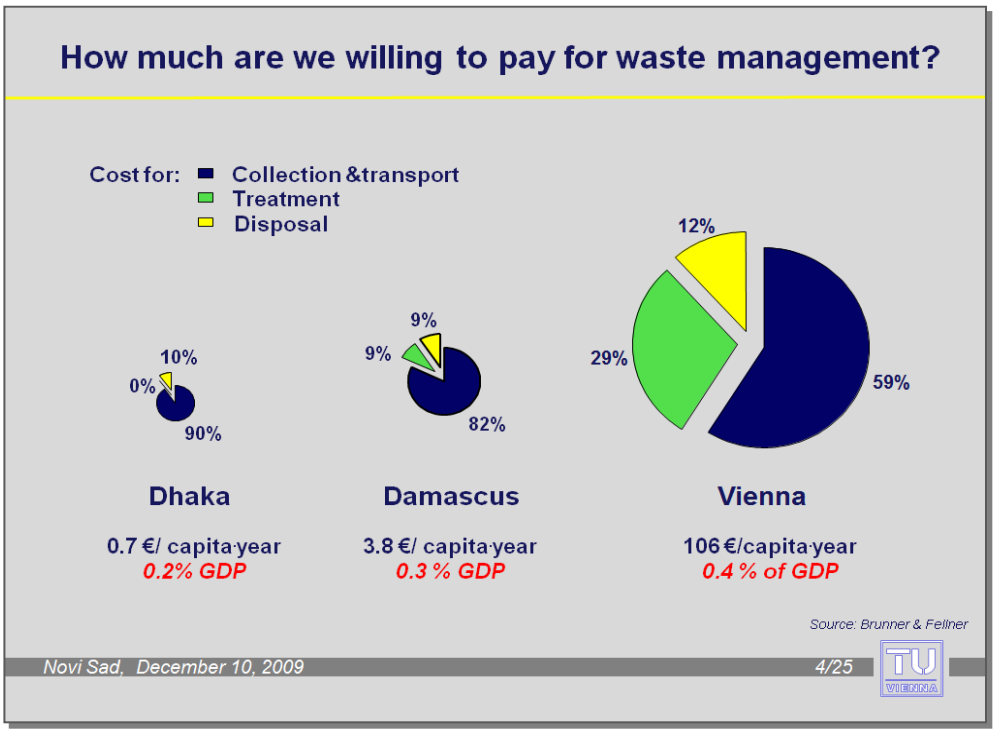
But even more helpful is the data that divides the total municipal budget for SWM by the population, and then expresses that as a percentage of the gross domestic product (GDP) per capita: Most of the world's cities waste management spending are in the range of 0.1 to 0.7 % of GDP/capita. [15]

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). [16]

Another major phenomena to note is that developing countries typically spend more than half of their waste budget in collection alone (mainly on labor 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. Figure 10 presents typical spending distribution in different countries.

Figure 10: Typical spending distribution in different countries [45]



4.4.4 Estimating 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. **Box 25** presents features of good performance indicators.

Basic performance indicators are presented as follows:

Box 25: Features of good performance indicators [48]

Good performance indicators are generally:

Objectives/outcomes focused — given external constraints, performance indicators should reflect whether suitable, measurable, clearly defined and achievable outcomes are being met.

Comprehensive but concise — a set of performance indicators should reflect all important objectives to demonstrate different aspects of overall performance, while not overwhelming users with information.

Transparent — performance indicators should be accompanied by explanatory material with the limitations and qualifications outlined, including those of the data.

Where possible, comparable data should be used to illustrate performance based on consistent definitions, both over time and across jurisdictions. However, there may be a trade off between the comparability of the data and its cost.

Timely and cost effective — there are practical considerations when developing performance indicators. Data used for performance indicators should be relevant for decision making and, therefore, need to be promptly available. There may be a tradeoff between timeliness and accuracy of data. The cost of data collection should not exceed the benefit.

4.4.4.1 Technical Performance Indicators

- *Collection rate (% of waste collected of total amount generated)*
- *Collection coverage (Number of people served as a % of the total population)*
- *Performance of waste processing plants (amount processed as % of design capacity)*
- *Quantity of waste processed per total waste generation*
- *Quantity of materials recovered (recycled) per total waste generation*
- *etc*

4.4.4.2 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*

4.4.4.3 Environmental Indicators

- *% of waste collected which is disposed of in a sanitary or controlled 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*

A comparison of status quo SWM in Vienna, Damascus and Dhaka and the selected indicators for the assessment of SWM systems is presented in Table 5.

Table 5: Comparison of status quo MSWM in Vienna, Damascus and Dhaka [45]

	Unit	Vienna (2002)	Damascus (2003)	Dhaka (2002)
MSW generation	[t/a]	850,000	450,00	1,400,000
Capita	[Mill.]	1.56	2	10
MSW/capita	[kg/capita/a]	545	225	140
MSW/capita/day	[kg/capita/day	4.5	0.6	0.4
Total Costs	[Mill.Euro/a]	169	7.5	6.6
0Costs per tonne MSW collected	[€/t]	200	18	10
Costs per capita	[€/capita/a]	106	3.8	0.7
Gross Domestic Product	[€/capita]	27,300	1,360	370
Costs MSWM/GDP	[%]	0.40	0.28	0.18
Selected Indicators for the Selected Indicators for the Assessment of Solid Waste Management Systems Assessment of Solid Waste Management Systems				
Percentage of population having direct contact with waste	[% of total population]	<0.01	5-10	40-50
N-emissions	[g N/capita/a]	7	41	170
Greenhouse gas emissions (CO2-equivalent)	[kg CO_2/capita/a]	27	98	92
Material recycling rate	[%]	25	7	6
Landfill volume required	[m^3/capita/a]	0.21	0.23	0.21
Disposal rate	[kg/capita/a]	167	187	129
Final storage quality		no	no	no

5. PLANNING A SWM PLAN

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.

5.1 Starting Up

5.1.1 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.*

5.2 Defining the scope of the Plan

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.

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.[49]

5.2.1 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. A selection of these factors is presented in **Box 26**.

Box 26: Selecting the Planning Area [50]

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.

5.2.2 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.

5.2.3 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. [49]

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.

Box 27 presents types of solid waste arisings that may need to be covered in the SWM plan.

Box 27: Types and definitions of solid waste arisings [50]

Household Waste: solid waste composed of garbage and rubbish that is the consequence of household activities. In some countries up to two thirds of this category consists of organic wastes.

Commercial Waste: waste from premises used wholly or mainly for the purposes of a trade or business or for the purpose of sport, recreation or entertainment. The waste typically consists of packaging and container materials, used office supplies and food waste.

Institutional Waste: waste originating in schools, hospitals, prisons, research institutions, and other public buildings. Where the institution involves residents, the waste composition is similar to those from households.

Street Sweepings: are materials such as sand, salt, leaves, broken glass, small pieces of metal, and other litter and debris removed from streets, parking lots and sidewalks in order to prevent these materials from being washed into storm sewers and surface waters, and to improve the appearance and safety of public roadways. Street sweepings are not as clean as virgin earth materials and should be handled with a certain degree of care. Street sweepings usually containlow levels of chemical compounds associated with stormwater runoff.

***Construction and Demolition Waste*:** Construction and demolition (C&D) materials consist of the debris generated during the construction, renovation, and demolition of buildings, roads, and bridges. C&D materials often contain bulky, heavy materials, such as concrete, wood, metals, glass, and salvaged building components.

***Sanitation Residues or 'night-soil'*:** these are human excreta residues collected from privies and latrines (often called 'night-soil') which, depending on the level of sewage provided, may be dumped in streets drains and therefore arise in drain clearing and street sweeping wastes.

***Industrial Waste*:** is waste produced by industrial activity, such as that of factories, mills and mines. Composition is site specific and depends upon the natural resources, raw materials and markets which provide the base for a given industrial activity. It may include liquid, sludge, solid or hazardous waste

5.3 Setting Objectives & Targets [51]

5.3.1 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:

- *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*

are often identified in SWM plans.

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

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)

Boxes 28 & 29 present examples of national objectives that might be incorporated in a SWM plan.

Box 28: Example of general objectives for SWM

Policy and legal framework

- Harmonization of national policy and legislation in the field of waste management with the National policies and legal provisions and with the provisions of international agreements and conventions to which the Country is a party.
- Integration of the problematic of waste management in the Sectorial and company policies.
- Increasing the efficiency of application of legislation in the field of waste management.

Institutional and organizational aspects

- Adjustment and development of the institutional and organizational framework in view of fulfilling the national requirements;

Human resources

- A*ssurance of human resources as number and professional qualification;*

Funding of the system of waste management

- Creation and use of systems and economic and financial mechanisms for the waste management in the conditions of observance of general principles, especially the principle "polluter pays";

Awareness of the parties involved

- Promotion of a system of information, awareness and motivation for all the parties involved;

Collection and reporting of data and information regarding the waste management

- Obtaining complete and accurate data and information that correspond to the reporting requirements at national level;

Prevention of waste generation

- *Maximization of prevention of waste generation;*

Recovery of the useful potential from waste

- *Exploitation of all possibilities of technical and economic nature regarding* the waste recovery;
- *Development of activities of material and energetic recovery;*

Waste collection and transport

- Assurance of serving a higher number of waste generators by waste collection and transport systems;
- Assurance of the best options for the waste collection and transport, in view of an effective recovery;

Waste Treatment

- Promotion of waste treatment in view of assuring a rational ecologic management;

Waste disposal

- Waste disposal according to the requirements of legislation in the field of waste management with the purpose of protecting the health of population and environment;

Research-development

- Encouragement and support of research in the field of waste integrated management;

Box 29: Example of objectives specific to specific waste flows

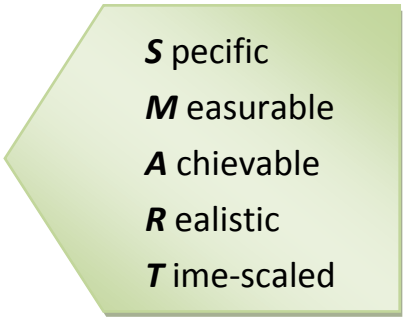
- Reduction of quantity of biodegradable waste by recycling and processing (minimization of the organic material for the reduction of pollutants issued by leachate and landfill gas);
- Increasing the degree of reuse and recycling of packages;
- Optimization of quantity of packages by packed product (by redesign);
- Reduction of quantity of packaging waste by recovery;
- Increasing the quantities of waste packaging collected and the efficiency of separate collection of waste packaging;
- Creation and optimization of schemes of material recovery;
- Creation and optimization of schemes of energetic recovery of waste packaging ("improper" for material recovery).

5.4 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 with in National Policies or Sector Strategies. [1]

Targets shall be 'SMART'.

Box 30 explains in what way goals shall be SMART



Box 30: SMART Targets in SWM planning [52]

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

- *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.*
- *Specific targets are straightforward and unambiguous. They emphasize what you want to happen.*

Table 6: Examples of framing targets [53]

Type	Examples	Pros	Cons
Absolute	Reduce landfill amount to 100 t/d by year X	Reduce actual pollution load to environment	Harder to achieve given economic and population growth
Relative	Reduce percentage of landfill to 40% by year X	Easier to attain under rapid economic growth	Total pollution to environment may still increase
Compare to expected trend	Reduce landfill rate by 20% by year X compared to business-as-usual scenario	More practical under rapid economic growth	Total pollution to environment likely still increase
Related to cost/value for money	Save 50% government fund to incineration by year X	Provide financial incentive and rewards	Environment effectiveness is unclear

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.

Box 31 presents an example of targets, the UK national targets that have been established in order to meet the obligation of the EC Landfill Directive (99/31/EC) to reduce the biodegradable municipal waste sent to landfill.

Box 31: Summary of National Waste Management Targets in UK concerning biodegradable waste diversion from landfills.

The UK is bound by the EC Landfill Directive (99/31/EC) which sets mandatory targets for the reduction of biodegradable municipal waste sent to landfill. The UK national targets are:

- By 2010 to reduce biodegradable municipal waste landfilled to 75% of that produced in 1995;
- By 2013 to reduce biodegradable municipal waste landfilled to 50% of that produced in 1995;
- By 2020 to reduce biodegradable municipal waste landfilled to 35% of that produced in 1995.

To help meet these requirements, the Government has established national targets for recovery of municipal waste and recycling/ composting of household waste:

National recycling/composting targets:

- To recycle or compost at least 25% of household waste by 2005
- To recycle or compost at least 30% of household waste by 2010
- To recycle or compost at least 33% of household waste by 2015

National recovery targets:

- To recover value from 40% of municipal waste by 2005
- To recover value from 45% of municipal waste by 2010
- To recover value from 67% of municipal waste by 2015

5.4.1.1 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*

5.4.1.2 Prioritization of of Objectives & Targets

Objectives and targets shall be listed and prioritized. [53]

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.

Another option is following a decision matrix that allows analyzing the actions against certain criteria. A sample decision matrix is shown in the following Table 7.

Table 7: Examples of ranking objectives/targets/actions [53]

Objective/Target/Action		
No	**Factor**	**Rate on scale of 0 to 10**
1	Long-term benefits	
2	Short-term benefits	
3	Economic feasibility	
4	Self reliance	
5	Outcomes beneficial for more than one stakeholder	
6	Growth in terms of knowledge	
7	Improvement in standard of living	
8	Other (specify):	
10: Highly positive outcome ***0: Neutral*** ***NA: Not applicable***		

5.4.1.3 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.

5.5 Tracking Options

The purpose of this step is to identify the practical options (or alternative solutions) available for addressing each of the component parts o f 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. All though 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 is 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 private 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 32 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 32: Key Issues of Setting Up a SWM system in developing and transition countries [12]

- *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 materials 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.

5.5.1 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.

5.5.2 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 kebside 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 often more expensive. [18]

In addition current legislation may determine in detail the structure of a collection system, and similarly the introduction of collection systems may be farthered by new legislation laying down which type of collection system should be chosen. [18]
As far as recycling is concerned planners shall keep in mind that some waste streams are special due to requirements for recycling. [18]

5.5.3 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*
- *Incineration (Waste to Energy)*
- *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 (See **Box 33**).

Box 33: Failure Cases of MSW Treatment Facilities [28]

- *1970s/80s West Africa*

A number of incinerator plants built but never used. Problems included waste being too wet to burn, no foreign exchange set aside for spare parts, and even building the incinerator but not the access road to deliver waste to it.

- *1979 Asia*

A mechanized compost plant was constructed for municipal wastes. Insufficient attention paid to the technical feasibility of the process, ease of plant maintenance, mixed character of waste and lack of reliable demand for compost product. Plant did not perform properly and had long periods of closure.

- *1986 South Asia*

Flagship incinerator funded by a European country. Worked on-and-off for a number of years. Calorific value of waste lower than anticipated, so required support fuel to burn. Facility proved uneconomic and ineffective.

- *1990s South-East Asia*

Planning study recommended landfill for 2000 tonnes per day of municipal solid waste. Incinerator company persuaded municipality to build incinerator for 200 tonnes per day (10% of the waste). Effect was to double total cost of implementing the plan. When built the incinerator did not work as intended: waste too wet/calorific value lower than anticipated. So, rather than generating electricity, incinerator required support fuel to burn waste. Plant shut down.

5.5.4 Financial Options

Are described in detail in the following sections.

5.6 Analyzing Options

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*

5.7 Creating Scenarios

Based on the principles of scenario planning (see **Box 34**), 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:

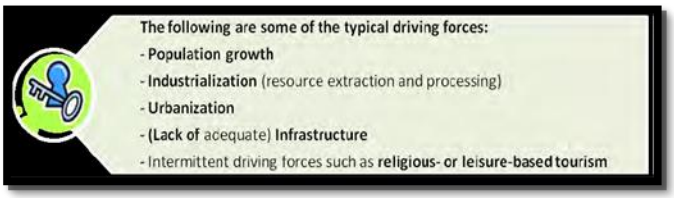
- *Alternatives in terms of technical waste treatment / management*
- *Alternative locations of waste management infrastructure (referring mainly to waste treatment plants, material recovery and recycling facilities, waste transfer stations and landfills)*
- *Alternative zoning in terms of common waste 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)*

In addition **Box 35** illustrates examples of alternative SWM approaches in SWM planning.

Box 34: Scenario Planning

Scenario planning is a process in which citizens and planners analyze the major trends and forces that may shape the future of an area or region to predict possible future conditions or outcomes. It is not an attempt to predict the future, but rather a tool that enables planning partners to prepare for the future by evaluating multiple potential development options, identified in the previous step. Planners may use various techniques to assess trends in key factors such as transportation, environment, and land use to develop alternative future scenarios that reflect different trend assumptions and tradeoffs.

Figure 37 present typical driving forces influencing the dynamic of SWM systems. Therefore it is essential that the created scenarios should be further refined and modified to address changing conditions. [54]



Driving forces in SWM [1]

Steps in Scenario Planning

Scenario planning is a demanding task which is in general described below.

Steps in scenario planning

In **step 1** planners shall define the driving forces influence SWM and in **step 2** to determine how these forces could combine to influence future conditions.

Step 3 is the creation of scenarios by thinking through the different driving forces in future environments

Step 4 planners have to analyze the implications of each scenario developed, considering transportation, land use, public investment and environmental policies and other key factors.

Scenario has to be evaluated in **step 5** by measuring them against each other and comparing the implications of each

Finally **step 6** monitors the implications as time goes by, so that each scenario can be further fine-tuned and modified as needed as the future unfolds. [54]

Box 35: Creating scenarios: an example from waste management in Lazio, Italy [55]

Baseline scenario

In the baseline scenario (2008) waste collection is performed with highly polluting diesel trucks (Euro 2) using street bins, recycling and composting rates are very low. A total of seven municipal biological plants (MBTs) are operating and two incinerators burn refuse-derived fuel produced in the MBTs; a total of nine landfills are operating where waste disposal occurs mostly without pre-treatment.

Alternative scenario 1: Waste Strategy

The first alternative scenario is taken from the regional waste plan (Waste Strategy) and it considers the period up to 2016 and foresees an increase in recycling and composting rate up to 60%, using door-to-door collection of waste. The strategy is intended to recover the material (especially paper and glass), and to use various mechanical and biological treatment processes to turn mixed wastes into refuse-derived fuel for energy recovery through incineration/gasification. In 2016, only the stabilised organic fraction after composting will reach landfills and only iron and metals will be separated. The increasing recovery of materials will reduce the use of landfills and they will not accept waste without pre-treatment. According to the plan, six new plants for processing waste (2 gasification plants and 6 new MBTs) will be built by 2016, while the number of landfills will remain unchanged.

A 'door-to-door' selective waste collection will be implemented to reduce the unsorted waste production, and to increase the selective waste collection. In terms of waste transportation, special attention will be given to the renewal of the trucks collecting bins with smaller and less polluting vehicles. For example, in the historic centre of the city of Rome waste collection will be performed by electric vehicles, while in the remaining parts of the city both natural gas vehicles and low emission diesel vehicles will be used. For a portion of the city of Rome, waste transportation will be performed by trains from an intermediate station to the final destination.

Waste collection and treatment can have an effect on occupational health and rates injuries on workers. When planning collection systems, special care will thus be taken to avoid heavy lifting and strain from handling containers, as well as the prevention of injuries at incineration, composting or recycling plants.

Alternative scenario 2: Green policy

The second alternative scenario was designed to provide the most sustainable waste management, in which a radical application of the EU waste hierarchy principles of reduction of waste (-15% over baseline) and high recycling/composting rates (70%) and progressive closure of landfills are applied. Waste prevention will be a key factor: if the amount of waste generated in the first place is reduced and sorted in the appropriate way for recycling, then disposing of it will automatically become simpler. As a consequence, in the green scenario there will be a reduction in the number of the operating plants: two incinerators, six landfills and seven MBTs. The criteria for which some plants will be closed are based on the number of people resident nearby, emission levels, and age of the treatment plant. In addition, in the large central area of the city within the railway ring, waste collection and transportation will be performed with electric vehicles.

5.8 Assessing 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. In order to evaluate the different scenarios number of decision making tools can be utilized.

Box 36 present basic principles in waste decision making process.

Box 36: Principles of Waste Decision Making

Waste decision-making should be based on the following principles:

- Individuals, communities and organizations should take responsibility for their waste;
- In taking decisions there should be consideration of alternative options in a systematic way;
- Engagement with the local community and key stakeholders should be an important and integral part of the decision making process;
- The environmental impacts of possible options should be assessed looking at both the long and short term;
- Decisions should seek to deliver the environmental outcomes that do most to meet the objectives shall take account of what is feasible and what is an acceptable cost.
- In developing their strategies, authorities should also take account of any government forecasts of municipal waste arisings and advice on realistic expectations of the proportion of waste that can be recycled.

Those principles can guide the decision makers in order to formulate their own criteria and procedures. Here are some suggestions for the practical decision – making regarding waste management.

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 [56]. 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

For the profile of the examined area, the following key-points are proposed.

Table 8: Minimum data for the profile of the examined area [56]

MINIMUM ELEMENTS	COMMENTS
Problems due to waste mismanaged	**Key points for the proposed solutions**
SW amount-trends-spatial distribution **SW composition-trends** **Seasonal variations**	It concerns all kinds of SW
Estimate combustible fraction **Estimate recyclable fraction** **Estimate organic fraction** **Estimate inert fraction**	Basis for the feasibility estimation
Existing facilities	See if there are some that can be utilized
Current collection and transfer cost	Basis for comparison with future cost
Current treatment and disposal cost	Basis comparison with future cost
Main economic activities	Basis for the outline of treatment product market
Trends for economic development	Basis for setting an upper limit for SWM cost
Trends for social development	Basis for determination of education-sensitization-awareness measures
Authorities that are involved in SWM	Basis for the future institutional development

For the technologies under discussion, the data presented in Table 8 has to be gathered. In addition for the technologies products, the following questions must be answered (see **Boxes 37 & 38**).

Box 37: Critical Questions for the formulation of a technology profile [56]

CRITICAL QUESTIONS
1. Is the technology proven?
2. Is there a reference list with similar facilities?
3. Which is the most suitable waste?
4. What types of waste can be accepted?
5. What are the mechanical, physical and chemical processes of the waste treatment?
6. Which are the residues and the by- products of each separate process?
7. Which is the composition of the residues and how can they be managed?
8. Which are the end products of the whole process?
9. Which are the possible markets for the end process?
10. Which will be the added value by the use of the specific technology?
11. Which is the investment cost?
12. Which is the net operational cost per ton of processed waste?

Box 38: Critical Questions for the formulation of the end product profile [56]]

CRITICAL QUESTIONS
1. Which are the possible uses of the product?
2. Is there a proven experience by the use of the product?
3. Which are the specifications of the product (composition, form, etc.)?
4. Are there suitable markets or potential users for the product in the examined area?
5. Is there an opportunity of transferring the product somewhere else?
6. Which is the total market capacity for the product?
7. Who will undertake the delivery of the product?
8. Which could be the lower price for the products?
9. Is the product disposition guaranteed??

Finally, the following set of criteria is proposed for establishing the decision – making procedure (See Table 9).

Table 9: A proposed multicriteria system for the comparison of scenarios [56]

CRITERIA GROUPS	CRITERIA
SOCIAL CRITERIA	Accordance with the legislation status Social acceptance
ENVIRONMENTAL CRITERIA	Non reversed environmental impacts Long term effects at Human Health Contribution to green-house effect and acid-rain Odor emissions and control Waste water production and control Solid residues production and control Land consumption Noise pollution Aesthetic pollution Material recovery Energy recovery Waste volume reduction
ECONOMIC CRITERIA	Investment cost Way of financing Operational cost without income from product sales Compatibility with the trends of social-economical development Estimated income from product sales
TECHNICAL CRITERIA	Flexibility – adaptation to seasonal variations Operational needs Reliability-reference list

5.9 Using 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.

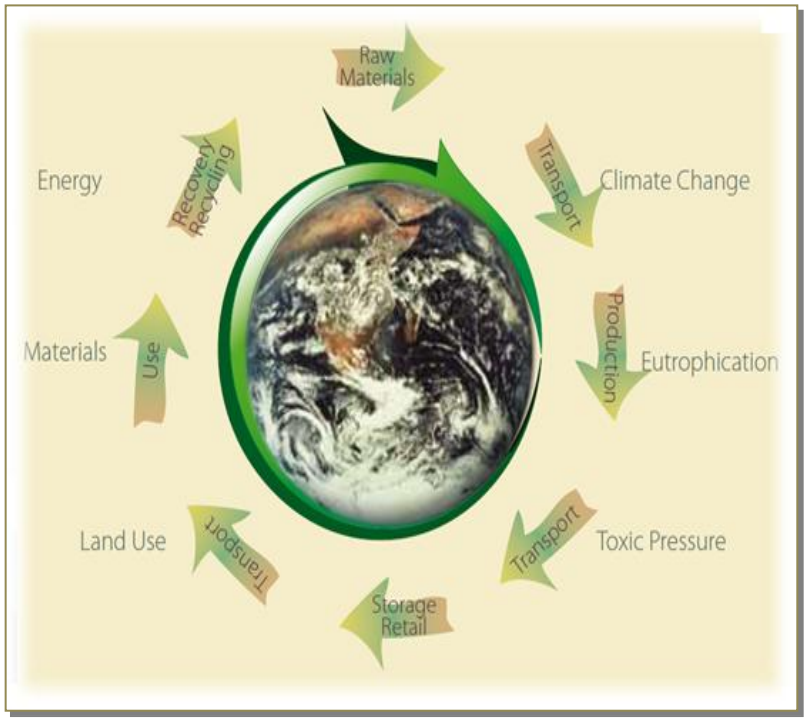
Since EIA and SEA are procedural tools, different analytical tools may be used as parts of the process.

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. [57]

5.9.1 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 11). [58]

Figure 11: Life cycle thinking [58]



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.

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?*

Box 39 provides a practical example of how Life Cycle Thinking has been applied to answer these kinds of questions

Box 39: Life cycle thinking the example of Copenhagen [59]

Following new statutory requirements on waste collection, the city of Copenhagen needed to look into new options for managing drinks packaging waste, in particular for metals and plastics.

To help with decision-making, a Life Cycle Assessment was carried out to complement an economic evaluation.

The purpose was to see whether the existing collection and treatment strategy could be replaced by a more efficient one, both from an environmental and economic perspective. The environmental evaluation took into account impacts such as emissions of greenhouse gases and acidification, measured in tonnes of CO2-equivalent and SO2, respectively.

Four alternative scenarios were studied and compared to the existing strategy, which involved collection with other types of household waste, followed by incineration:

- *Collection for recycling at existing glass bottle banks*
- *Street collection for recycling*
- *Centralised collection at recycling centres*
- *Separate collection in containers next to the existing glass bottle banks*

The assessment concluded that street collection (alternative 2) is preferable from a purely environmental perspective

(230 tonnes of CO2-equivalent, and 0.6 tonnes of SO2 saved) with collection at existing glass bottle banks (alternative 1) in second place, saving 110 tonnes of CO2-equivalent and 0.4 tonnes of SO2.

However, a combined environmental and economic assessment showed that the collection of plastic and metal at existing bottle banks (alternative 1) proved to be the best option. This has become the new management strategy for used metal and plastic drinks packaging in Copenhagen.

This example demonstrates that life cycle approaches can be applied to a well-defined situation at city level and illustrates how Life Cycle Assessment can be used to complement a purely economic analysis. It can help find solutions that are better for the environment while also considering financial constraints.

Cost Benefits 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 emphasised 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”. [60]

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. [61]

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. [62]

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. [57]

5.10 Prioritizing 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*

5.11 Creating the 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.

6. IMPLEMENTING A SWM PLAN

6.1 Utilizing Instruments for Successful Implementation of a SWM Plan

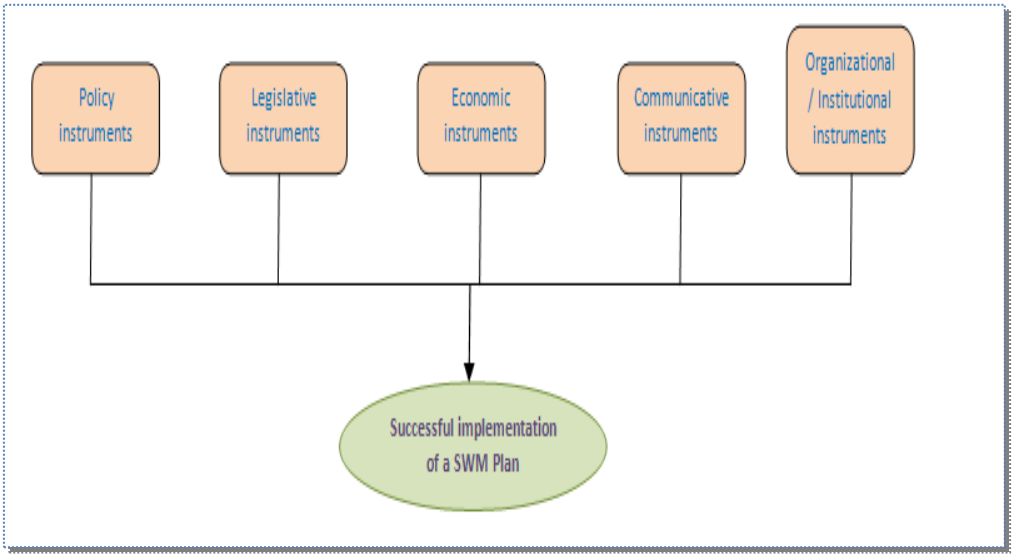
The way that a SWM Plan is implemented defines in great extent how successful it is going to be. The implementation of a Plan by itself plays a crucial role because if the equipment or the facilities that have been designed during the Planning process are not implemented in a proper way, they will not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

In order to assure the proper implementation of a SWM Plan, they have been developed certain instruments (see Figure 12), 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 12: Instruments for the successful implementation of a SWM Plan



6.1.1 Policy Instruments [63]

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. It aims to integrate environmental considerations in the design of products to reduce environmental pressure during the entire lifecycle of the products. Reduction of environmental pressure is for example achieved by reducing the use of hazardous substances or increasing the recyclability of products.*
- *Environmental agreements between industry and the authorities, to produce environmental friendlier products. These agreements may be a useful approach to reduce the environmental impact from industrial activities. Often, industry has been given a choice of either fulfilling certain legal requirements or entering an agreement on how to reach a set of targets.*

Box 40 provides indicative examples of policy instruments from Europe.

Box 40: Examples of Policy instruments from Europe[18]

Producer Responsibility for WEEE in Sweden

Producer responsibility has become a popular measure during recent years, mainly because it implements the polluter pays principle and hence reduces costs borne by the local authority. Furthermore, the decision on how to set up systems to handle producer responsibility is usually made by the producers themselves. On the other hand, financial issues may be less transparent to the public.

In Sweden an Ordinance on Producer Responsibility for waste from electrical and electronic equipment (WEEE) came into force on 1 July 2001. The producer bears inter alia the obligation to take back old equipment free of charge when the customer buys a new product and to present a take-back plan to the local authorities.

In Sweden an Ordinance on Producer Responsibility for waste from electrical and electronic equipment (WEEE) came into force on 1 July 2001. The producer bears inter alia the obligation to take back old equipment free of charge when the customer buys a new product and to present a take-back plan to the local authorities.

See at: http://www.internat.naturvardsverket.se/index.php3

Dutch Packaging Covenant

When the Dutch government transposed the Packaging Directive into Dutch legislation, various obligations on individual producers and importers of packaging were imposed. However, the packaging supply chain was given an opportunity to conclude a covenant in which the relevant parties would agree on how the obligations in the regulation would be implemented. The second Packaging Covenant was signed in 1997. One of the targets in the covenant is that the growth in the quantity of packaging being placed on the market must be limited to the growth in GDP less 10%. A third Packaging Covenant is being negotiated.

See at: http://www2.minvrom.nl/pagina.html?id=5001

6.1.2 Legislative Instruments [63, 64]

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.*

Box 41 provides a paradigm of legislative instrument.

Box 41: Paradigm of Legislative instrument

European Environmental policy has set as objective to reduce the use of landfills by its state members. For this reason it has set a number of legislative instruments, one of which is Directive 99/31/EC on the landfill of waste. The Directive imposes to all member states to gradually reduce the amount of Biodegradable Municipal Waste (BMW) that is sent for landfilling. More specifically, the amount of BMW sent for landfilling in 2006 should have been reduced to 75% of the total amount by weight of BMW generated in 1995, in 2009 to 50%, while the target for 2016 has been set to 35%.

6.1.3 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. [64] 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. [18]

Indicatively, they are mentioned the following economic instruments:

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

An example of economic instrument is provided in **Box 42** following, which presents the principle of the Pay As You Throw (PAYT), one of the most important trends for the charges on waste collection, and some of its main benefits.

Box 42: The "Pay As You Throw" Principle and its main benefits [65]

In recent years-particularlyin the United States, Australia and Canada– waste collection charges are determined according to the "polluter pays" principle. The charge is called either "unit pricing" or "variable rate pricing", whereas the whole charging system is called Pay As You Throw (PAYT). The PAYT charging system aims to minimize-reduce waste production through a direct connection between the actual amounts of waste that each household produces with the waste collection charges.

More specifically, according to PAYT, waste collection charges should be proportional of the waste amount produced by each household and not a defined amount of money determined e.g. by the size of somebody's apartment/house, as it is done even nowadays in many countries around the globe. In that way, it can be told that they are developed economic incentives both for reduction of the waste production per capita and promotion of recycling.

The main benefits that may arise from the implementation of PAYT e.g. in a municipality, can be summarized as follows:

- *Minimization – reduction of municipal waste produced*

  Case studies of PAYT implementation in the United States of America showed an average reduction in waste production varying from 14% to 27% (Gordon H. Jr, 1999). The system's users, motivated by the economic incentives that PAYT sets, change their consuming behavior, by buying environmental friendlier products, "forcing" in that way companies to adapt their products and packages. In addition, it has been proved that PAYT systems that charge its users according to the volume of waste that they leave for collection, has led users to compress their wastes.

- *Increase in citizens' participation in recycling and composting programs*

Recycling and composting are the most common ways for civilians to reduce the amount of waste that leave for collection. According to EPA US, it has been documented an increase in participation in recycling programs, in municipalities that have implemented PAYT charging systems, varying from 32 % to 59 % (Gordon H. Jr, 1999).

- *Reinforce of Waste Management practices hierarchy*
- *PAYT promotes the idea of waste reduction in source and the recycling or composting of the produced waste. In addition, it provides to citizens a fair charging system, according to the services provided and to the amount of waste they produce.*
- *Environmental public awareness – Citizen's participation*

Citizens identify the effect of waste disposal to the environment and they have the chance to reduce their contribution, saving the same time the fees or the charges that have to pay for the provision of the service.

- *Limitation of environmental impacts*

  Less wastes means less pollution.

- *Reduction of managerial, operational and administrative costs*

  This type of reduction arises from the limitation of the managerial and operational tasks, reducing as a result and the administrative needs of the service.

- *Increase in the efficiency of the service provided*

  Because of the reduction of the managerial costs for the same task (waste collection), it increases the overall efficiency of the system.

- *Promotion of a better public image of the cleaning services*

Costing and charging procedures are more transparent, not to mention that charges are fairer for the citizens.

6.1.4 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

6.1.4.1 Information & 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. [SWM] 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. [18] 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. [1]

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.

The motivating information will often be national, regional and local campaigns informing and motivating people to be "waste aware". It could include campaigns that explain why the public should actively participate in waste management. **Box 43** provides indicative forms on how to strengthen public awareness, whereas **Box 44** outlines what should be the objectives of an Environmental Awareness Center, based on the case study of the city of Pune, India.

Box 43: Indicative forms for the spread of information – strengthen of public awareness [1,18]

- ✓ Advertisements on the Internet
- ✓ Putting up a dedicated and simple informative website
- ✓ Thematic Workshops
- ✓ One to one meetings
- ✓ Establishment of an Environmental Awareness Centre
- ✓ Use of broadcasting media
- ✓ Mass education activities such as articles in newspapers, speeches, etc.
- ✓ Poster contests and exhibitions

Box 44: Establishment of Environmental Awareness Centre in the city of Pune, India [1]

The core purpose of this centre will be building up an environmentally aware and well-informed community – an essential first step in developing an improved environmental ethic within the community. It will provide services for the public with easy access to environmental information and it will be a venue for environmental education programs for schools, community organizations, businesses and residents. Environmental Awareness Centre will facilitate as a venue in the city of Pune which will be utilized by PMC, all other stakeholders like industries, NGO's, educational institutions and the citizens for spreading information and awareness about various waste management techniques and issues.

6.1.5 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. [1]

6.1.5.1 Capacity Building [1]

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. An example of the actions required by city/civic authorities so as to deliver a proper SWM system is described in **Box 45**.

Box 45: Example of how city/civic authorities should build capacities, so as to operate properly a SWM system [1]

- **Special training to unqualified staff:** They may be sent for training to institutions responsible for designing special courses for sanitation workers and supervisors.
- **Refresher course at all levels of staff:** Refresher course should be conducted for the sanitation workers as well as supervisory staff at least once in every 5 years, or they should be sent for training to prepare themselves with the advances made in the field.
- **Exposure to elected members:** If these members are given appropriate orientation towards the modernization of solid waste management and importance of the same in terms of sanitation and health they would be able to overcome the financial and other administrative hassles and strengthen the implementation of the action plan. They would also help in gaining the public support through their network of field workers.
- **Promotional Opportunities:** To retain the supervisory staff in the department adequate promotional opportunities should be made available in the decentralized SWM hierarchy. This also helps to maintain their interest in their job.
- **Building partnerships:** The Department of Solid waste Management should develop working partnerships with the organizations in the public and private sector and also community groups by providing support to their businesses on resource and waste management.

6.1.6 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*
- *Join 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.[50] 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.

6.1.7 Implementation Program [63]

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 programme 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.

7. MONITORING, EVALUATING & REVIEWING A SWM PLAN

7.1 The Role of Monitoring & 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. [1, 63]

Box 46: Goals while monitoring and evaluating a SWM system [66,67]

Monitoring the performance of a municipal (or regional, or district) SWM system has a number of goals:

- To observe closely the quality of the SWM service provided in order to maintain or improve service quality;
- To encourage the efficient use of available resources;
- To relate the outputs of a service to inputs (and ultimately their cost);
- To improve service quality overall and relative to cost;
- To enforce accountability of service providers;
- To put downward pressure on cost of service provision;
- To compare and assess services provided against the targets set out in municipal SWM strategy Plan;
- To provide information on which management can make policy and management decisions about the service;
- To compare the service provided in different areas (e.g. between two or more sub-municipalities or municipalities in a regional association);
- To compare the quality of service provision in a specific area with a previous month or year;
- To monitor and evaluate the quality of services provided by private service contractors;
- To check whether the services being provided are those that local people want or need;
- To check the system's progress;
- To create a basis for future planning;
- To demonstrate whether resources – time and money – have been used effectively;
- To explain to funders what it has been achieved and how successful it is.

Box 46 provides specific goals while monitoring and evaluating a SWM system, **Box 47** presents the characteristics that evaluation should have in order to be effective, while **Box 48** provides an indicative list of the monitoring activities of a SWM system.

Box 47: Tips for successful evaluation of an Action Plan [1]

Evaluation of the Action Plan is most effective when:

- It is a continuous (not just one-off) process informing planning and delivery as the project develops;
- It involves all those with an interest in the project in defining the questions they want answered;
- It uses imaginative and creative approaches, which engage those involved;
- It helps projects to be more accountable to the wider community;
- It highlights and celebrates successes and achievements;
- It encourages an honest appraisal of progress, so that you can learn from what hasn't worked as well as what has.

In many occasions monitoring and evaluation of a SWM system is believed to be the same. However, it is not, because monitoring is the process of collecting and providing the necessary information and data for a SWM system's performance, while evaluation is the process of using this information and data, to calculate and assess the system's performance. In other words, it can be said that monitoring is a key part of the evaluation process, providing the input (info & data) to deliver the output (evaluation outcome).

Box 48: Indicative list of a SWM system's monitoring activities [63, 64]

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.*

7.2 Conducting Monitoring & 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. [19] 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.* [67]

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. [19] **Box 49** provides a characteristic paradigm of this.

Box 49: The results of a formal analysis [67]

In many occasions and especially in low income countries, lack of funds is identified as the main cause for the low performance of components of the SWM system in a municipality. However, a detailed analysis of, e.g. a collection service, might reveal that performance could be much improved through improving routing, staffing or more effective management, none of which would truly require any substantial increase of management.

Box 49 shows in the best way the need for having a better and more in depth knowledge of a system's performance. 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. [1,63]

7.3 Using 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. [1]

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. [19]

Box 50 defines the characteristics that PIs should have.

Box 50: Characteristics of Performance Indicators [1]

In order to be handy, useful and helpful for the monitoring a SWM system, Performance Indicators should be:

- *Quantifiable* – Creating a PI for which data cannot be realistically gathered or corroborated should be avoided.
- *Actionable* – It should be possible for the public authorities to influence the outcome of a PI through concrete measures that they can take. A very "high level" PI does not lend itself well to a strategy. For e.g. "citizen satisfaction" is a very high level PI which is influenced by a host of factors. It will not be possible to create a set of strategies that can affect this PI unless the exact nature of "dissatisfaction" is clear.
- *Outcome oriented* – A PI should represent an outcome and not a strategy to achieve the outcome. The Municipality should be free to weigh the options and pursue any strategy to achieve better performance and thus improve every PI.
- *Symptom vs. Indicator – Often citizens' behavior is an outcome of the nature of service delivered. A PI should reflect a facet of the actual delivery of service, not an outcome of the service.*
- *Answerable to all citizens* – A PI should relate to an outcome (operational or financial) that affects all citizens and not individual stakeholders in the service. In a Public-Private partnership, that the Municipality might enter in order to deliver a service, the nature of the PPP is not subjected to assessment, only the outcome of that partnership is. While it is understood that the exact terms of the PPP will heavily influence the outcome, the PPP itself is a strategy. If the PPP fails to deliver the expected outcome measured by an indicator, the Municipality should evaluate the terms of the PPP or even dissolve such a partnership, but this should be considered as a strategy choice.

7.3.1 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. [1]

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.*

Box 51 provides useful tips concerning Perfomance Indicators, whereas **Box 52** presents a summary overview of Perfomance Indicators for a SWM system, categorizing them per issue.

Box 51: Tips about Performance Indicators [1,63]

- Performance Indicators are a fast way to provide information to various stakeholders and on regular basis about the status of a SWM system.
- Targets are a requirement of great importance for the proper use of Performance Indicators in order to assess if outcomes have been achieved.
- One of the most important Performance Indicators related to a SWM system, which is usually looked upon as a barometer of the overall system's performance, is the year on-year reduction of waste generated and/or disposed.
- The overall cleanliness of a city is also considered to be another key parameter to be measured.
- The indicators should be used to monitor the performance of both government institutions (to ensure a transparent and accountable government), as well as the private sector engaged in waste management.
- A Performance Indicator is a quantitative measure of whether the system is delivering its service at the desired level. In order to evaluate a Performance Indicator, appropriate data must be gathered by the concerned department using a certain methodology.

Box 52: Summary Overview of Performance Indicators Related to overall SWM of a region [68]

Issue	Indicator
Health	➢ Morbidity and mortality rates due to illnesses related, directly or indirectly, with solid wastes, such as, cholera, tetanus, dengue fever, teniasis, hepatitis, etc, by urban and peri-urban zones
Economy	➢ Number of workers employed in the solid wastes sector. ➢ Number of large, middle, and small companies involved in urban sanitation (fabrication of mechanical equipment, contracting firms of urban sanitation, recycling industries, consulting agencies, maintenance shops, and others). ➢ Weight percentage of solid wastes recovered over the total of solid wastes generated. ➢ Increase in the number of tourists relative to the previous year.
Environmental Conditions	➢ Weight percentage of MSW collected over MSW generated. ➢ Weight percentage of MSW properly disposed over SW collected.
Social Conditions	➢ Percentage of peri-urban population provided with collection services over total peri-urban population. ➢ Annual increase/ decrease in number of waste pickers in final disposal (past 5 years). ➢ Number of community health education programs.
Solid Waste Generation	➢ Per capita production (kg/person/day): Total tonnage of solid wastes collected per day divided per thousands served.
Recovery	➢ Tonnage of solid wastes recovered per day divided by tonnage of solid wastes generated per day multiplied by 100.
Coverage and Access to Urban Sanitation Services	➢ Urban collection: Urban population served divided by total urban population multiplied by 100. ➢ Peri-urban collection: Peri-urban population served divided by total peri-urban population multiplied by 100. ➢ Urban composition: Peri-urban population divided by total urban population multiplied by 100.
Management, Operation and Finance:	➢ Number of employees of sanitation service per thousand persons served. ➢ Rate or tariff of urban sanitation monthly average per home, in US$. ➢ Payment capacity: minimum monthly rate or tariff of urban sanitation versus income or monthly minimum salary (%). ➢ Budget of sanitation service versus total municipal budget (%). ➢ Capital investments vs. total budget of urban sanitation service (%). ➢ Income generation through tariffs and rates versus total cost of the service (%). ➢ Efficiency of collection (%):: Value collected divided by value billed multiplied by 100. ➢ Unit cost of sanitation service (US$/ton): Sum of all direct annual costs, indirect costs, social benefits, contract payments, financial costs, depreciation and others, divided by tonnage received at site of final disposal per year.

Box 52: Summary Overview of Performance Indicators Related to overall SWM of a region [68]	
Issue	**Indicator**
Other Recommended Indicators:	➢ Coverage of street sweeping (%): length of paved streets swept divided by the total length of paved streets multiplied by 100. ➢ Efficiency of collection equipment maintenance (%): Total equipment divided by number of equipment in operation + reserve equipment + equipment in maintenance multiplied by 100. ➢ Number of bills paid per month versus total number of bills issued per month multiplied by 100. ➢ Billing index (%): Number of commercial establishments that receive bills divided by number of premises served multiplied by 100.

7.3.2 Data Collection [1, 66]

In order to extract reliable PIs, they are required accurate, reliable and regular data collection;

- accurate and reliable cost accounting procedures;
- weighing of wastes;
- availability of details on the nature of SWM service operation;
- units to which the performance indicators can be related (e.g., costs per 1000 of population served, costs per household, time per tonne of waste collected, etc.). [67]

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.*

Boxes 53 provides a number of methods for gathering this type of additional information, whereas **Boxes 54** and **55** provide an indicative list of data requirements related to collection and disposal services, two of the most important activities related to SWM, that municipalities have to gather.

Box 53: Methods for gathering additional information [66]

This Box provides a list of methods for gathering additional information for monitoring and evaluation of an applied system. It is generally suggested to pick two or three of the following methods in order to get a rounded picture. It is mentioned that different methods for gathering information suit better in different projects. The methods are:

A questionnaire survey

A questionnaire survey can be used to find out more about the views and experiences of users, the wider community, agencies, etc. Use tick-boxes or questions that can be answered with a yes or no if you want to survey a lot of people, or ask a lot of questions. Questions that allow people to say more than just yes or no will give you more detailed information, but they take longer to fill in, a lot more time to analyze, and fewer people will fill them in. Responses to questionnaires are often low so think about offering a prize.

In-depth interviews

It is usually best to limit the number of in-depth interviews to those people whose involvement with the project gives them particular insights or valuable experience – but try to talk to a range of people who are likely to have different perspectives and views on your project.

Feedback forms

You can find out whether people have found your training and other events useful by asking them to fill in a short form. Ask them, for example, what they found most and least useful; what they might do differently as a result; what could be improved.

Focus groups and round tables

A 'focus group' gathers together about half a dozen people who are broadly similar (for example, they are all single parents with young children) to discuss themes or questions you want to address in the evaluation. A 'round table' discussion is a similar idea, which brings together people with different perspectives (for example, teenage parents, teachers, health visitors).

Diaries

Ask key people to keep diaries of their involvement with the project.

Press reports

Gather and review press reports on the area (for example, you could see whether positive reports about the area are increasing).

Observation

Take photographs of your area over time, to see if you can observe any changes. Observe who contributes to meetings or comes to your centre, and see whether this changes over time. This will give you an idea of which types of people you are reaching (men, women, younger, older) and which of these types of people are playing a more confident role in the project.

Case studies

In order to make the evaluation manageable, you might want to pick a few pieces of work (case studies) to explore in detail, rather than trying to explore everything. Pick pieces of work that illustrate your main objectives.

Evaluation workshops and review meetings

Hold special workshops/review meetings of people who are involved in your project and use pictures, photographs or models, as well as the spoken word, to get feedback from participants.

[Source: http://www.jrf.org.uk/sites/files/jrf/1859354157.pdf]

Box 54: Data collection requirements for municipalities to compile and Report Performance of the Solid Waste Collection Services [69]	Recommended Frequency of Data Collection
Overall Service Provision	
1. Tonnage Collected – Weighed or estimated vehicle loads	Daily
2. Population or number of households in area of municipality waste collection responsibility	Yearly
3. Population or number of households actually collected from	Yearly
4. Frequency of collection services by type, domestic, commercial, clinical, etc.	Yearly
5. Number of vehicles in municipality fleet by type, size, age, make, registration number	Monthly
6. Name of person responsible for solid waste collection service	Yearly
7. Management structure and numbers of persons involved in collection service designated: collection administration; maintenance	Yearly
8. Number of complaints received from public; nature of complaint and action taken	Weekly
Operational Information	
1. Number of collection vehicles operating and total vehicle hours worked	Daily
2. Number of persons operating collection service designated: collection administration; maintenance	Daily
3. Vehicle operational records by daily driver worksheet: • Identification of vehicle and driver • Vehicle hours working • Vehicle mileage covered • Vehicle fuel used • Number of vehicles trips to disposal sites • Number of operating personnel in vehicle crew	Daily
4. Vehicle operating costs by maintenance log for each vehicle: • Identification of vehicle • Fuel and oil • Tires • Routine servicing • Maintenance and repairs, recording description, cost and time to complete: Engine and transmission and brakes, hydraulic systems, chassis and suspension, body work and glass, other	Weekly
Financial Information	
1. Vehicle operating costs by vehicle and by fleet	Monthly
2. Labor costs: payroll plus overheads, consumables etc.	Monthly
3. All other solid waste collection departmental costs	Monthly
4. Total costs presented as full cost of the collection operation • Per ton of waste collected • Per person/household served • Per number of persons employed in solid waste collection	Yearly
5. Revenues collected from Tax	Twice yearly
6. Revenues collected from commercial and industrial waste producers • As a total sum • As a revenue per ton collected	Twice yearly

Box 55: Data Collection Requirements for Municipalities to Compile and Report Performance of the SW Disposal Services [12]	
	Recommended Frequency of Data Collection
Overall Service Provision	
1. Disposal site locations and type of operation; landfill, incineration, recycling plant, etc.	Yearly
2. Tonnage received-weighed or estimated vehicle loads and by waste type and by collection authority: • Domestic • Domestic and commercial • Commercial only • Clinical • Industrial – what type of waste and origin	Daily
3. Vehicles equipment and plant utilized in disposal operations by type, size, age, make, registration number	Monthly
4. Name of person responsible for solid waste collection service	Yearly
5. Management structure and numbers of persons involved in disposal service designated	Yearly
6. Number of complaints received from public: nature of complaint and action taken	Weekly
7. Environmental management at landfill and transfer station sites: pollution incidents, breaches of license conditions, remediation actions, frequency of environmental monitoring	Weekly
Operational Information	
1. Number of vehicles operating and total vehicle hours worked	Daily
2. Number of persons operating disposal service designated: operational administration; maintenance	Daily
3. Vehicle or equipment operational records by daily driver worksheet: • Identification of vehicle or equipment and driver • Vehicle or equipment hours working • Vehicle or equipment hours in-operational for maintenance • Vehicle or equipment hours in-operational for repair • Vehicle or equipment fuel used	Daily
4. Vehicle or equipment operating costs by maintenance log for each vehicle or equipment: • Identification of vehicle or equipment • Fuel and oil • Tires • Routine servicing • Maintenance and repairs, recording description, cost and time to complete: Engine and transmission and brakes, hydraulic systems, chassis and suspension, body work and glass, other	Weekly
5. Leachate management installed on site: • Quantity produced per day – estimated or measured • Type of treatment or disposal • Costs of operation	Yearly
6. Cover material used on site: • How often spread over waste • Estimated volume of material used	Yearly
7. Recycling and resource recovery systems and programs in operation • By municipality or private sector • Materials recovered and method of recovery	Yearly

Box 55: Data Collection Requirements for Municipalities to Compile and Report Performance of the SW Disposal Services [12]	
	Recommended Frequency of Data Collection
8. Transfer stations and bulk transportation operations: • Type, number of vehicles, tonnage transported and mileage covered	Monthly
9. Is there a weighbridge in consistent use at the landfill sites: Records kept of tonnage of waste being disposed	Monthly
Financial Information	
1. Plant operation cost for each site	Monthly
2. Labor costs: payroll plus overheads, consumables etc.	Monthly
3. All other solid waste disposal departmental costs	Monthly
4. Total costs presented as full cost of the disposal operation • Per ton of waste received • Per person/household served • Per number of persons employed in solid waste disposal	Yearly
5. Revenues from municipalities using disposal service (Proportion of Cleansing Tax)	Twice yearly
6. Revenues from receipt of commercial and industrial wastes	Monthly
7. Revenues or grants from any other sources	Twice yearly
8. Revenues from recycling and resource recovery operations	Monthly
9. Transfer and bulk haulage costs if applicable	Monthly
10.Capital repayments on loans for solid waste management projects: specify	Monthly

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. [66]

7.4 Operating a Management Information Systems [67]

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. [70]

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. **Box 56** provides the benefits of a MIS, while **Box 57** provides the steps for how to operate a MIS.

Box 56: Benefits of MIS [67]

- Though the provision of accurate, relevant, comparable and up-to-date management information, resources can be financially appraised and matched against outputs delivered;
- Annual budget proposals can be made on the basis of actual needs, taking account of changes in service characteristics, costs and revenues;
- Overall revenue requirements can be better established and politically and socially acceptable charging schemes be devised;
- Revenue collections can be improve through better mobilization of resources;
- Financial performance can be monitored against objectives;
- Investment planning and decision making procedures can be improved; and
- Information about the total cost and cost effectiveness of service provision give the SWM department a basis to judge performance on a comparative basis against specified criteria, and give a guide to future investment requirements.

Box 57: Steps to operate a MIS

1. Determine the PIs for the monitoring and the evaluation of the SWM system
2. Determine the data that need to be collected so as to extract the PIs
3. Choose the appropriate method to collect the data
4. Determine the frequency that data need to be collected
5. Collection, store and process of data

7.5 Reviewing 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. There could be a variety of explanations, some of which are presented in **Box 58**.

Box 58: Potential reasons for failing to meet goals or objectives set by a SWM Plan [66]

Problems with external circumstances

- The environment in which you are working has changed or worked against you (for example, local or national policies have changed, or a major employer has closed down).

Problems with carrying out your plans

- Departed from the original aims.
- Didn't allow enough time or resources.
- Changes in organization did not allow delivering what was originally planned (for example, a key worker left).
- The quality of performance has been lower than expected (for example, workers or members have not completed tasks they said they would do).

Problems with the ideas behind what you want to achieve

- The initial plans to make things happen have not been successful.
- The original aims were inappropriate (perhaps they turned out to be not what people wanted).

Different people involved in the project were working against each other and towards different goals.

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.

8. MANAGING RISKS

8.1 Risks & Risk Management

A Risk Management Plan is a useful tool in SWM planning absolutely required to ensure the successful implementation of the several interacting tasks and activities, without creating potential failure conditions.

Risk Management Planning is the process of deciding how to approach and conduct the risk management activities for a project. Planning of risk management processes is important to ensure that the level, type, and visibility of risk management are commensurate with both the risk and importance of the project to the authorities, to provide sufficient resources and time for risk management activities, and to establish an agreed-upon basis for evaluating risks. The Risk Management Planning process should be completed early during SWM planning, since it is crucial to successfully performing the other parts of the planning process. The result of Risk Management Planning is a Risk Management Plan. The risk management plan identifies and establishes the activities of risk management for the project in the project plan (RMP).

In order to have a successful RMP, the first step is Risk Identification where risks are identified that may affect the plan's ability to achieve its objectives. Risk Identification documents the risks that might affect the project and their characteristics. The Risk Identification is subsequently amended with the results from qualitative risk analysis and risk response planning, and is reviewed and updated throughout the project.

Risk identification is an iterative process due to the fact that new risks may arise through the project's life cycle and previously-identified risks may drop out. The frequency of iteration and the participants involved in each cycle will vary from case to case. The team responsible for the implementation of the SWM plan shall be involved in the process so that they can develop and maintain a sense of ownership, and responsibility for the risks and the associated risk response actions.

The Risk Identification process is required for the Qualitative Risk Analysis process.

Qualitative Risk Analysis includes methods for prioritizing the identified risks for further action, such as Quantitative Risk Analysis or Risk Response Planning. Authorities can improve the plan's performance effectively by focusing on high-priority risks. It also assesses the priority of identified risks using their probability of occurring, the corresponding impact on plan's objectives if the risks do occur, as well as other factors such as the time frame and risk tolerance of the plan's constraints of cost, schedule, scope, and quality.

Once the definitions are in place, planners shall assess the identified risks' probability and impact and then put them into high, moderate, and low risk categories for each project objective (time, cost, scope, quality). They rank risks by degrees of probability and impact, using the definitions in place, and include their assessment rationale.

Finally, the last step of the RMP is the Risk Response Planning. Risk Response Planning is the process of developing options, and determining actions to enhance opportunities and reduce threats to the project's objectives. It focuses on the high-risk items evaluated in the qualitative and/or quantitative risk analysis. In Risk Response Planning parties are identified and assigned to take responsibility for each risk response.

8.2 Strategies for Risk Response

Strategies for Risk Response include:

Avoid. Risk avoidance involves changing the SWM plan actions to eliminate the risk or to protect the SWM plan objectives (time, cost, scope, quality) from its impact. This might be achieved by changing scope, adding time, or adding resources (thus relaxing the so-called "triple constraint"). Some negative risks (threats) that arise early in the planning can be avoided by clarifying requirements, obtaining information, improving communication, or acquiring expertise.

Transfer. Risk transference requires shifting the negative impact of a threat, along with ownership of the response, to a third party. An example would be the authority transfers the financial impact of risk by contracting out some aspect of the work. Transference reduces the risk only if the contractor is more capable of taking steps to reduce the risk and does so. Risk transference nearly always involves payment of a risk premium to the party taking on the risk. Transference tools can be quite diverse and include, but are not limited to the use of: insurance, performance bonds, warranties, guarantees, incentive/disincentive clauses, A+B Contracts etc.

Mitigate. Risk mitigation implies a reduction in the probability and/or impact of an adverse risk event to an acceptable threshold. Taking early action to reduce the probability and/or impact of a risk is often more effective than trying to repair the damage after the risk has occurred. Risk mitigation may take resources or time and hence may represent a tradeoff of one objective for another. However, it may still be preferable to going forward with an unmitigated risk.

Table 10 presents an example of an indicative conventional risk matrix in SWM planning.

Table 10: Indicative conventional Risk Matrix for SWM plans

ID	DESCRIPTION OF RISKS	Likelihood	Impact	Risk Assessment
1.	**Design Risks** ➢ Design incomplete ➢ Unexpected geotechnical or groundwater issues ➢ Inaccurate assumptions on technical issues in planning stage ➢ Surveys incomplete ➢ Changes to materials/geotechnical/foundation ➢ Waste composition wrong or incomplete ➢ Unforeseen design exceptions required ➢ Consultant design not up to national standards ➢ Unresolved constructability items ➢ Project in a critical water shortage area and a water source agreement required ➢ Incomplete waste quantity estimates ➢ Unforeseen construction window and/or rainy season requirements ➢ New or revised design standard ➢ Construction staging more complex than anticipated	L*	M*	L
2.	**External Risks** ➢ Landowners unwilling to sell ➢ Local communities pose objections ➢ Unreasonably high expectations from stakeholders ➢ Political factors or support for project changes ➢ Stakeholders request late changes ➢ New stakeholders emerge and request changes ➢ Threat of lawsuits ➢ Increase in material cost due to market forces ➢ Water quality regulations change ➢ New permits or additional information required ➢ Reviewing agency requires longer than expected review time ➢ Changes to storm-water requirements ➢ Permits or agency actions delayed or take longer than expected ➢ New information required for permits ➢ Environmental regulations change ➢ Controversy on environmental grounds expected ➢ Pressure to deliver project on an accelerated schedule ➢ Lack of administration and management capacity from the relevant authorities involved	H*	M-H	H
3.	**Environmental Risks** ➢ Environmental analysis incomplete ➢ Availability of project data and mapping at the beginning of the environmental study is insufficient ➢ New information after Environmental Document is completed may require re-evaluation or a new document ➢ New alternatives required to avoid, mitigate or minimize impact ➢ Acquisition, creation or restoration of on or off-site mitigation ➢ Design changes require additional Environmental analysis ➢ Unforeseen – unexpected conditions found after EIA has completed ➢ Unanticipated cumulative impact issues ➢ Changes in local spatial planning	L	H	M

ID	DESCRIPTION OF RISKS	Likelihood	Impact	Risk Assessment
4.	**Organizational Risks** ➢ Inexperienced staff assigned ➢ Losing critical staff at crucial point of the plan ➢ Insufficient time to plan ➢ Functional units not available, overloaded ➢ Lack of understanding of complex internal funding procedures ➢ Priorities change on existing program ➢ Inconsistent cost, time, scope and quality objectives ➢ Overlapping of one or more project limits, scope of work or schedule ➢ Funding changes for fiscal year ➢ Lack of specialized staff ➢ Capital funding unavailable for right of way or construction	M	H	H
5.	**SWM Risks** ➢ SWM plan overall goal and need is not well-defined ➢ SWM plan objectives definition is incomplete ➢ SWM plan, schedule, targets, cost, and actions are not clearly defined or understood ➢ No control over staff priorities ➢ Consultant or contractor delays ➢ Estimating and/or scheduling errors ➢ Unplanned work that must be accommodated ➢ Lack of coordination/communication ➢ Underestimated support resources or overly optimistic delivery schedule ➢ Scope creep ➢ Unresolved SWM planning conflicts not escalated in a timely manner ➢ Delay in earlier SWM planning phases jeopardizes ability to meet programmed delivery commitment ➢ Added workload or time requirements because of new direction, policy, or statute ➢ Local agency support not attained ➢ Public awareness/campaign not planned ➢ Unforeseen agreements required ➢ Priorities change on existing program ➢ Inconsistent cost, time, scope, and quality objectives	L	M	L
6.	**Right of Way Risks** ➢ Possible changes in design and relocations require more time than planned ➢ Unforeseen ownership issues ➢ Objections to Right of Way ➢ Need for “Permits to Enter” not considered in SWM plan schedule development ➢ Acquisition of land parcels controlled by Public Authorities take longer than anticipated ➢ Inadequate pool of expert witnesses or qualified appraisers	M	M	M

* L: Low, M: Medium, H: High

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