# CHAPTER 8: ASSET MANAGEMENT

## 8.1 INTRODUCTION

A water and sewerage utility has certain unique characteristics when compared to other utilities in terms of the size of its asset base and the 'capital intensity' of its operations. These utilities are often faced with the problem of ageing pipe networks and the associated increasing costs. Recent studies undertaken in the UK, Australia and USA have shown that water utilities need to make substantial investments in capital maintenance projects involving renewal of existing assets to enhance the capabilities of the assets to maintain existing service levels and to meet any new or improved service requirements.

Asset Management comes to the fore when making decisions related to asset operations and maintenance in order to provide quality services at low cost to consumers, whilst maintaining and protecting the environment. It is an approach which allows the asset base to be managed in a way which ensures that future investments deliver maximum benefit for customers and service providers. Though asset management of these networks is largely concerned with determining capital maintenance investment strategies and achieving the lowest life cycle cost is one of its key objectives, it is not restricted to just capital maintenance investment planning. Ideally, it also covers the whole of the asset life cycle including design, procurement, operation and reinforcement of assets. It is a way of thinking that considers capital, operations, maintenance, repair, renewal and replacement as investment decisions. It has the ability to optimally allocate capital and operational expenditure to achieve short-term value and long-term sustainability.

***"Asset management is a combination of management, financial, economic, engineering and other practices applied to (physical) assets with the objective of maximising the value derived from an asset stock over the whole life cycle, within the context of delivering appropriate levels of service to customers, communities and the environment and at an acceptable level of risk."***

The three key elements of asset management are 'adequate/appropriate service levels', 'cost effective' and 'risk' and can be summarised as "the art of balancing performance, cost and risk. Achieving this balance requires support from the pillars of competence: management, engineering and information" (Brown and Humphrey).

Following are the benefits of the asset management as listed by the USEPA (http://water.epa.gov/infrastracture/sustain/asset_management.cfm)

a. Prolonging asset life and aiding in rehabilitation, repair and replacement decision through efficient and focused O&M.

b. Meeting consumer demands with focus on system sustainability

c. Setting rates based on sound operational and financial planning

d. Budgeting focused on activities critical to sustain

e. Meeting service expectations and regulatory requirements

f. Improving responses to emergencies

g. Improving the security and safety of assets

h. Reducing excess costs for both operation and capital expenditure

i. Maintaining desired levels of services

In this chapter the need, basic concept, asset documentation, periodical asset assessment, for STP, SPS, and sewers is briefly explained. A model to start with for Indian sewerage system is introduced. In addition, review of practices in Japan is given in Appendix C. 8.1.

## 8.2 NEED FOR ASSET MANAGEMENT

The underlying infrastructure required to deliver quality water and sewerage services to all are the pipe networks and the supporting treatment and pumping systems. In practice, the physical infrastructure assets created in urban areas have generally been deteriorating due to inadequate attention and/or improper O&M. Little effort has been made either to manage these assets efficiently. Maintenance activities are typically reactive, wherein maintenance is only resorted to when there is a very obvious breakdown in the service. Such a strategy eventually results in even greater infrastructure deterioration and yet more frequent extended breakdowns in the existing poor levels of service.

The fixed assets form the core of the service but similarly, little effort has been made to achieve self-sustainability of those services. Water and sewerage utilities in the country cannot generate sufficient revenue from consumers when tariffs are set so far below the operating costs of service provision.

Due to the rapid increase in the urban population, the priority of the utility managers has been to increase the service coverage by installing new infrastructure. The fiscal flows to the sector have also laid emphasis only on the creation of new physical assets. Under the existing system, wherein there is already a financial deficit, this need for a large amount of capital would possibly result in further deferred maintenance towards the existing older assets. With the present shortfalls in revenue and the resultant lack of planned maintenance activities, the challenge of maintaining the functional sustainability of the service becomes increasingly difficult.

The performance study carried out by CPCB (2006) on 115 STPs indicated that only 72% of capacity of STPs could be utilised. The performance was also reported to be poor.

As for STP and SPS, the following failures have been reported:

- Mechanical and electrical equipment like; mechanical screen, pumps, pre-treatment units, mechanical grit removal, sludge-handling facilities, flow measuring devices were out of order
- Concrete facilities in some parts, such as digesters were damaged.

Aging pipe defects are also reported to be causing the cave-ins on roads, and are caused due to the following:

- Pipe joints allow water and soil to leak through and this not only causes the sewer to silt, but also weakens the pipe bedding due to loss of soil around the pipe.
- Hydrogen sulphide induced corrosion in sewer crown weakens the pipes and causes cracks.
- Bricks of manhole are cracked and groundwater infiltrates into the sewer.

To address the goal of maintaining sustainable water and sewerage services, infrastructure asset management has been developed and is being used as a tool for maintaining serviceability because it promotes the sustainable use of the physical assets and environmental resources by a systematic process (NAMS and IPWEA, 2001).

## 8.3 BASIC CONCEPT OF ASSET MANAGEMENT

A statutory asset management procedure is not seen in the sewerage sector in India and each local administration seems to find its own ways of managing the assets. Asset management is the art of balancing performance cost and risk and is a series of organisational strategies, activities and systematic and coordinated practice by which an organisation manages its infrastructure rationally. It requires competencies in three fundamental areas of knowledge: management (financial, economic and organisational), engineering, and information.

In order to implement these, there are five key questions that need to be answered.

- What are the current conditions of the infrastructure?

The answer requires making an inventory of the existing physical assets and assessing their condition and their current value, taking into account their expected remaining useful life and replacement cost.

- What level of performance can be expected from the infrastructure?

The answer requires an understanding of the performance objectives of each stakeholder, of legal and contractual requirements and of current levels of performance.

- In the current system, what are the most critical components that will safeguard the required performance in a sustainable manner?

This requires analysis including knowing under what circumstances failures occur, how they occur and with what probability. It is also necessary to understand the costs of repair and to assess the consequences of each mode of failure.

- What are the minimum costs over the life cycle that will have to be allowed for?

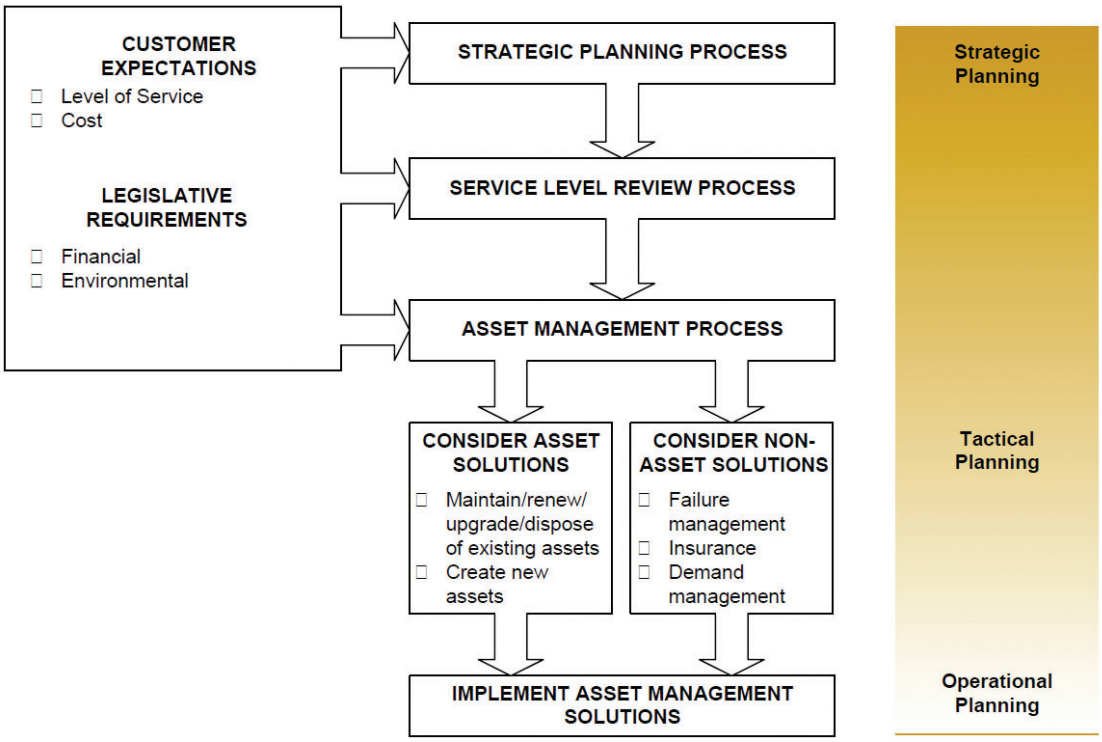
It is necessary to identify the direct and indirect costs to budget for, and to estimate their respective amounts. It must also be borne in mind that the O&M costs may not be constant over the life cycle because the forms of failure increases with the age of the asset.

This strategic implementation involves identifying current investment, O&M practices and analysing the most viable alternative management options for the organisation in question.

- What is the best long-term investment strategy to adopt?

Answering this question requires investment planning and identifying how to finance it (Alegre, 2009).

In addition, as shown in Figure 8.1, asset management can be an integrated process of decision-making, planning and control over the acquisition, use, safeguarding and disposal of assets to maximise their service delivery potential and benefits in response to community needs, and to minimise their related risks and costs over their entire life.




Source: Municipal Indaba, 2008

Figure 8.1 Schematic diagram of Asset Management

## 8.4 ASSET MANAGEMENT FOR SEWAGE TREATMENT PLANT AND PUMPING STATION

STP and SPS have a large number of assets such as civil structures, electrical and mechanical machinery, which are called above-ground assets because of their location relative to the ground surface. Asset management practices which are brought to bear on above-ground assets are distinct from the asset management practices utilized for underground asset management, mainly because physical inspection of these assets and therefore, assessment of their condition and performance is possible. Not only are above ground assets which are predominantly mechanical and electrical equipment more visible and they are likely to have much shorter asset lives.

The asset management for equipment of STPs and SPS proceed as follows:

a. Preparation of a database on STP equipment, inspection data, repair data and failure data

b. Setting the criteria by which plant managers can easily know a suitable time for replacing or improving aging facilities at their STPs. The plant managers can refer to both Table C8.1.2 and Figure C8.1.8 in Appendix C 8.1.

c. Making a scenario of repair and replacement of equipment

d. Selecting optimal scenario to decide priority projects so as to minimize risks.

e. Drawing up of mid and long-term financial plans for securing project funds.

## 8.5 ASSET MANAGEMENT FOR SEWER

The underground sewer network constitutes about 70–80% of an average sewerage utility – requiring high initial investment with subsequent network maintenance, which are extremely necessary for sustainability of the service.

Asset Management for sewer is as follows:

a. Preparation of a database on sewers, road sinkhole, and pictures from CCTV cameras to understand the present condition of sewers and compilation of this data

b. Drawing up mid- and long-term maintenance plans for deciding priority projects so as to minimize risks.

c. Drawing up mid- and long-term financial plans for securing project funds.

## 8.6 MODEL TO START WITH FOR INDIAN SEWERAGE ASSET MANAGEMENT

To start with, the asset documentation must cover the following:

### a. Asset documentation in Indian sewerage situation

First of all, it is very difficult to ascertain the asset's condition due to the following reasons:

i. The sewer pipelines are laid underground.

ii. Assets are generally created or laid over a long period of time.

iii. The records of the assets may be old, incomplete, inaccurate or missing.

iv. Due to the labour intensive O&M, historical knowledge about the assets may be inadequate.

To document the assets, the following steps may be taken:

i. The staff and officers who were involved in construction and O&M should be interviewed

ii. The engineering drawings of the assets should be digitized.

iii. Physical / visual observations of the "above-ground" and visible assets should be made

iv. Interview selected long-term residents to cross-check the maps

v. Match the on-road manholes with the records to record additions, if any

vi. Allocate an alpha-numeric code to components to retrieve details on software

vii. Interact with ISRO and use GIS to update the computerized data.

**b. Condition of the assets**

The condition of the assets should be physically checked and recorded by a separate team. This will specifically inform about how long the equipment can be expected to serve without renewals.

**c. Organizing the asset inventory**

There are many options to record the data on asset inventory:

i. Hand written inventory
ii. Commercial software for recording asset inventory
iii. Generic data base software
iv. Spreadsheets

The best option is specifically designed asset management software, which will be very flexible in recording the asset data and retrieving the reports depending upon the requirements. However, such software is costly. The generic database software is inexpensive but requires time and commitment to set up the database for input of data and generation of reports. The spreadsheet and hand written inventories may be considered temporary solutions.

**d. GIS**

The GIS contains a graphical representation of the location of sewerage assets belonging to a number of sewerage asset classes, especially:

a. Sewers
b. Manholes

Enterprise asset management (EAM) solutions help utilities improve asset performance and tracking. The asset management component of GIS software gives user-friendly access to tracking, locating, and managing assets. It also creates:

a. consolidated view of operations and increases information
b. availability across the organization.

Once these are finished, an asset register can be developed with the following:

i. Cost of construction/purchase cost
ii. Other details of the asset (if pipeline, the material of the pipe such as CI/DI/Stoneware, etc.)
iii. Date of commissioning
iv. Location of the asset
v. Additions to the asset (Example: Adding one more screen)
vi. Major repairs of capital nature

vii. Deletions to the asset (Example: Demolishing unused room, etc.)

viii. Rate of depreciation (It will vary for each category of asset)

ix. Year-wise depreciation

x. Value after depreciation

xi. Date of disposal

xii. Value of disposal

xiii. Scrap value

**e. Capital maintenance cost of the assets**

This is perhaps the greatest challenge and has to be compiled essentially from personal enquiries and records and built up step by step.

To estimate the cost of replacement, the following may be adopted:

i) If the utility had recent improvements, such as pipe replacement/renewal/repair, the cost per metre of the pipe can be used.

ii) The cost obtained from sister organisations may be used for similar projects.

iii) The estimates prepared in the recent past for similar projects may also be used.

iv) The standard rates may be adopted for preparation of estimates.

Once these are compiled, the balance sheets for capital works and O&M can be built up step by step, as shown in Figure 8.2 and Figure 8.3 overleaf, which present an elementary model to start the asset management documentation to suit the sewerage systems.

## 8.7 ASSET DOCUMENTATION AND DISCLOSURE

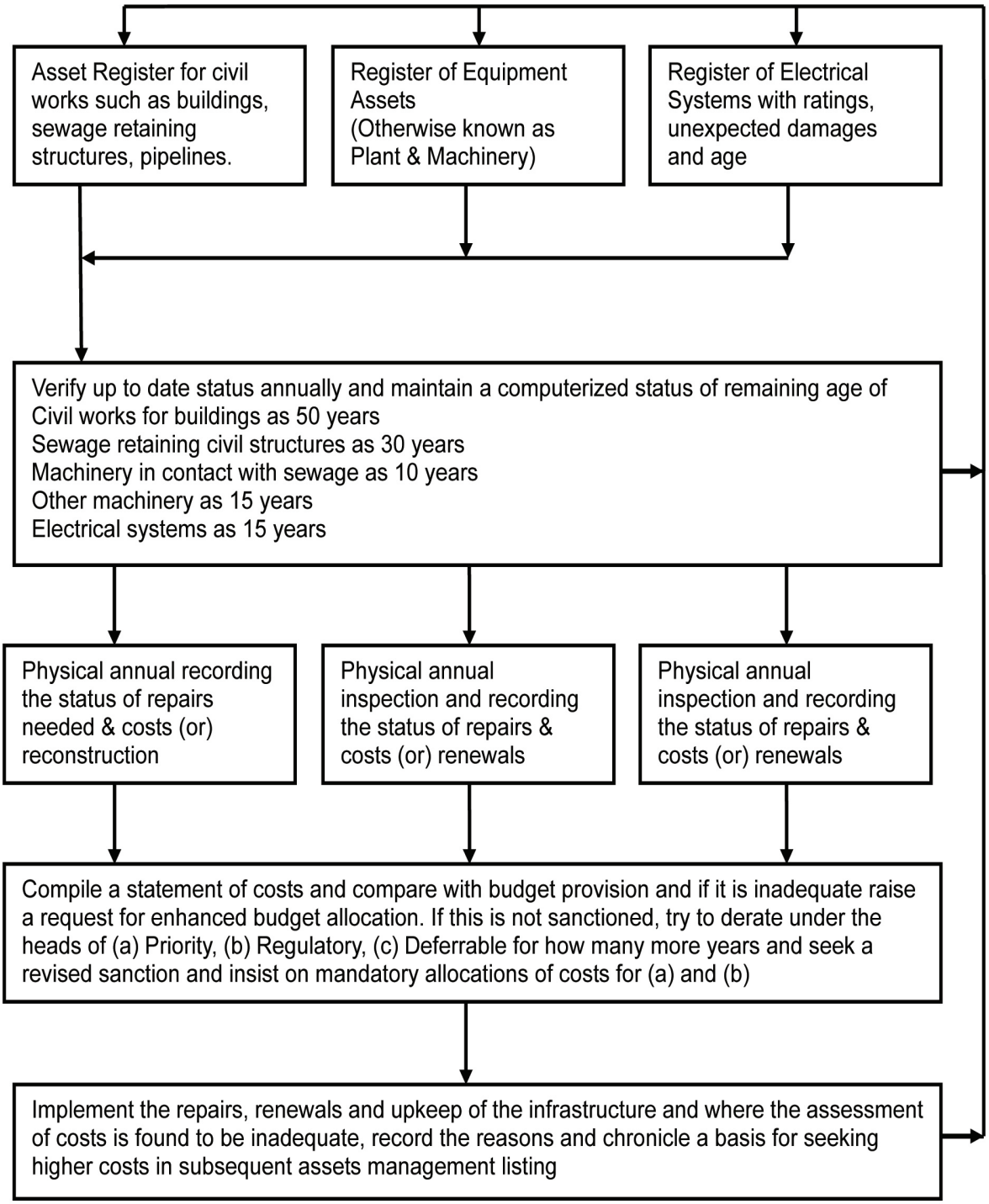
Customers are not only beneficiaries of sewerage services, but also main players because they are tariff payers and users of sewer connections. Accountability to local residents needs to be satisfied using stock management method that regards new construction, maintenance and reconstruction and rehabilitation as one process.

Therefore, public involvement is needed as follows:

a. Strategic planning process: When the service level and cost is decided, the customer involvement is necessary. After completing the documentation, it should be disclosed to the public by internet, information bulletin or relevant counter at the city hall.

b. Service level review process: After assessing the asset management plan, documentation should be disclosed by Internet, information bulletin or relevant counter at the city hall.

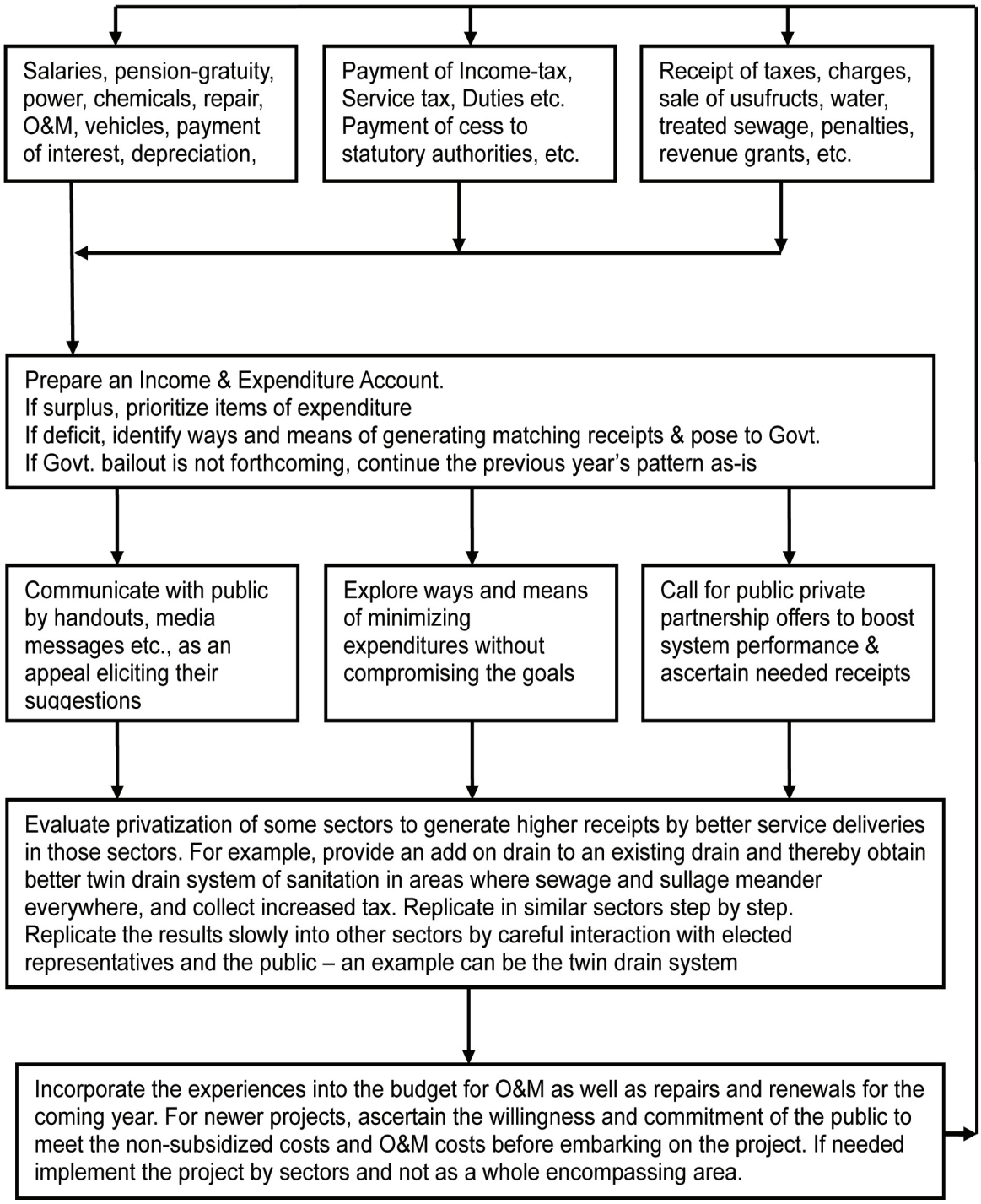
For public official, the documentation enables easy communication with the users.




Note:

All departments do maintain their own registers of infrastructure work components but mostly, budget allocations for repairs; renewals, etc., are based on the previous year's allocation. This does not account for the life cycle and the need for increased budget in a given year if the particular infrastructure component is due for renewal by a new one. The above system will help in establishing a realistic claim. It is advisable to renew equipment as whole units. For example, a compressor is better taken as compressor, motor, suction & delivery piping & valves all together.

Figure 8.2 Simplified Sewerage Asset Management for the Infrastructure




Note:

Sometimes, the annual budget is in deficit and even deposits in the banks are foreclosed once in a while to meet expenditures. Due to this the routine maintenance goes to the back bench and only emergency maintenance is done to avoid criticism by public. It is necessary that sub cost centres are identified and user charges revised to cover the expenditure such as salaries, power, chemicals, repairs & maintenance, operation of vehicles, interest and depreciation. The consumers should be made to understand that a healthy public utility organization alone can provide a quality service to the people. For example, a decentralized sewerage and incremental sewerage along with differential tariff of tax and charge for these areas will make the exercise easier to manage and slowly making surplus in revenue.

Figure 8.3 Simplified Sewerage Asset Management in O&M and Seed Money

## 8.8 PERIODICAL ASSET ASSESSMENT

It is necessary periodically to check and assess the progress of the plan on the basis of plan-do-check-act principle. If there is some deviation, the plan needs to be modified by the cause analysis. In addition, periodical asset assessment is essential to cope with the social needs and changes toward sewage works. Since the plan is based on assumption such as asset risk and estimation of necessary budget, the periodical review and fine-tuning of the plan is necessary.

## 8.9 FINANCIAL ASPECT

In the financial sense, asset management is the optimization of finances like stocks, bonds and derivatives in the face of threats from expected risks and expected good from profits. In sewerage, a major part of expenditure is on O&M. The proper operational asset management deals with existing assets of hardware such as pipes, pump sets, civil works, equipment, etc.

Thus, maintaining these assets in a trim condition results in efficient functioning of sewerage systems to a level that is satisfactory to the public. If people are satisfied, the tariff can be increased, and they will pay willingly. Therefore, asset management in infrastructure must focus on life cycle assessment of equipment, following the preventive maintenance and re-ordering level where needed. The financial asset management shall ensure adequate fund flows at stated times. An easy way to understand the asset management in its financial, human resources, satisfied public and finance aspects is shown in Figure 8.4 and Figure 8.5 overleaf.

Figure 8.4 illustrates that the infrastructure system which can be conceived as sewerage in this case and always responding to the four-sided compression of (a) limited budget, (b) performance requirements, (c) less public acceptance and (d) higher legal requirements like staff, salaries, etc. If all these act at the same time, the system has to collapse and if one of them increases the pressure, the other three should have the ability to be resilient for the system to remain stable.

If this resilience is not there, the shape of the rectangle will be altered and the system may respond without any control. For simplicity, let us consider a situation described below.

**Cause**

- A sewage pumping station has a worn out pump set and sewage stagnates all the time in sewers and back flows on roads in the mornings.

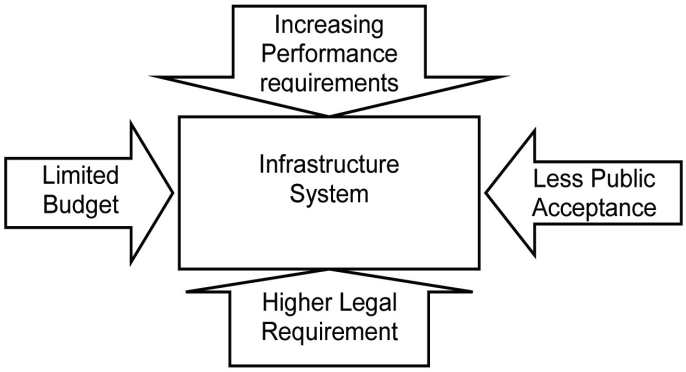
**Responses of the system**

a. The immediate effect is less public acceptance.

b. The next is higher legal requirements as people may go to the court of law.

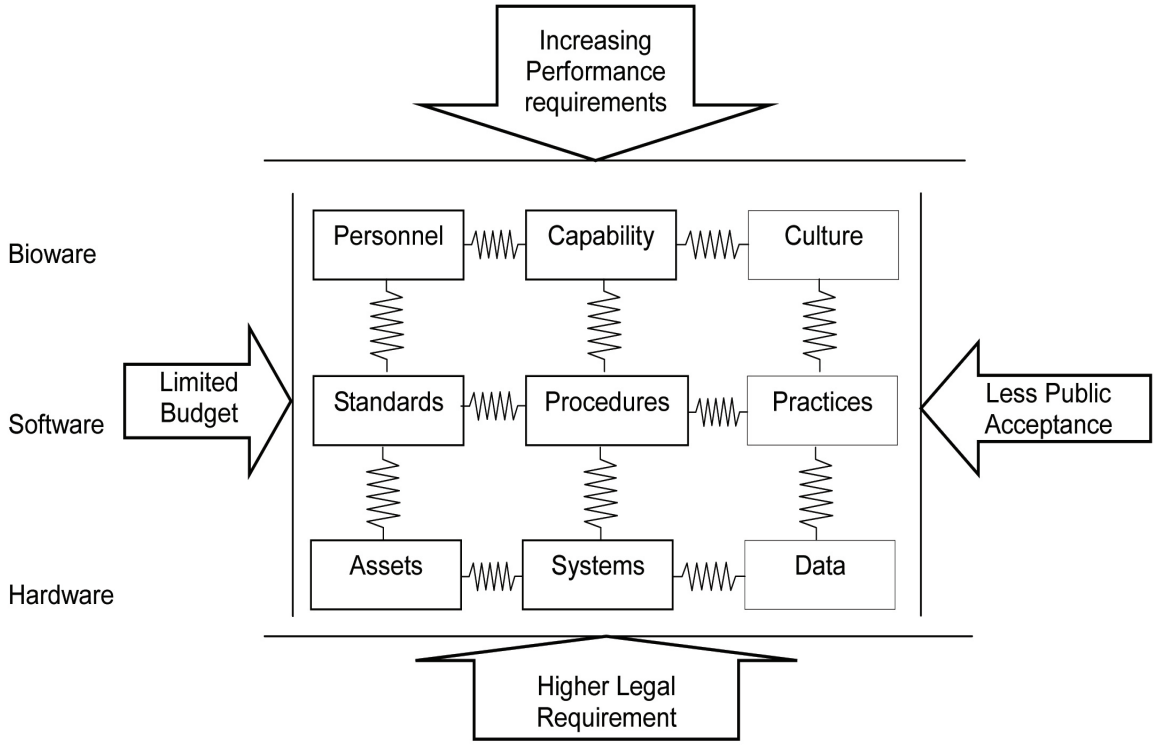
c. The next is increasing performance requirements as directed by the court.

d. The limiting factor is the restricted budget and this necessitates temporary repair for the system to go on.




Source: Ype C. Wijnia

Figure 8.4 Depiction of forces acting on infrastructure assets and the directions of their impacts as opposing each other




Source: Ype C. Wijnia

Figure 8.5 Depiction of mass spring example of response of assets to forces when one or more are altered and final equilibrium

The next time the defect occurs, even the temporary repair may not be possible and replacements will be needed incurring higher expenditure. Figure 8.5 illustrates the situation of the sewerage system in a dynamic state. If there is slack in the springs it will readjust and become stable. In this case, the slack is to be reconciled as the following.

**Hardware**

- The availability of spare parts, critical spares and if possible, a standby pump set which could be fitted in a short time (or) a standby pump set which can be operated.

**Software**

- The availability of reserve funds and emergency power to operate it and human resources trained to implement these measures. This is referred to as software because they can be “programmed” and people “trained”.

**Bioware**

- The personnel habits, the work culture and capability to respond are matters of intuition and are not fully guided by mathematics, logic or procedural regulations. This is a method by which the system and the human resources act together.

It is to be recognized that asset management between financial allocations, training human resources and standardizing the re-order level procurements are all required to act at the same time.

## 8.10 SUMMARY

Occurrence of asset failures of sewerage system in India is not uncommon. The asset management is a suitable management system for not only improving performance of a sewerage system but also ensuring sustainability of the sanitation service provided. Many utilities in India have very little information about the assets they own and how they are performing. The creation of a database containing information about physical assets and their locations is therefore a fundamental starting point for asset management, and gradually building it up with the data regarding asset condition and performance is required for its effective implementation.