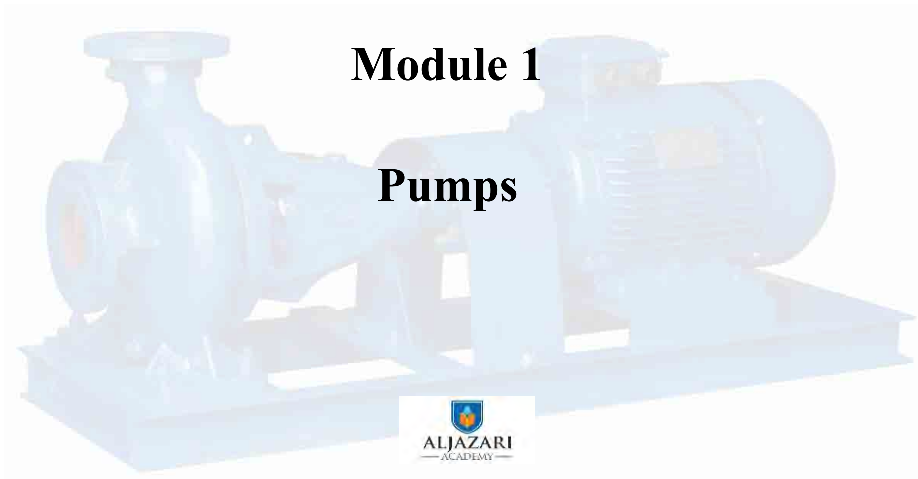
添付資料 3.45

2017 年春期研修「O&M of Mechanical Equipment」の教材

O & M of Mechanical Equipment
WSD 5231



Module 1

Pumps

Topics to cover..

- ✓ Importance of equipment in WASA operations
- ✓ Selection criteria of pumps
- ✓ Assembly components

Topics to cover..

- ✓ Pump operations
- ✓ Preventive maintenance of pumps
- ✓ Troubleshooting of pumps

Icebreaker and Class Introduction

Now it is your turn…

- Degree and backgrounds?
- Share your work experience relative to WASA equipment?

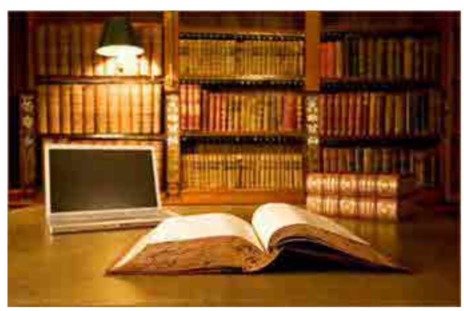
Brainstorming

Now it is your turn…

- Any prior experience on Pumps?
- Why interested in this Module?
- What best skills do you bring to the class?

Resources and Handouts

- Owner's Manual, KSB Pumps
- Pumps and Pumping (Arasmith, S. 2006)
  ACR Publications, London
- Participant lecture notes, Module 1
- Class presentations, Module 1



Resources and Handouts

- O and M of Pumps Manual
- JICA, Manual on sewerage and sewage treatment,
  Part B: Operation and Maintenance,
  Ministry of Urban Development, New Delhi

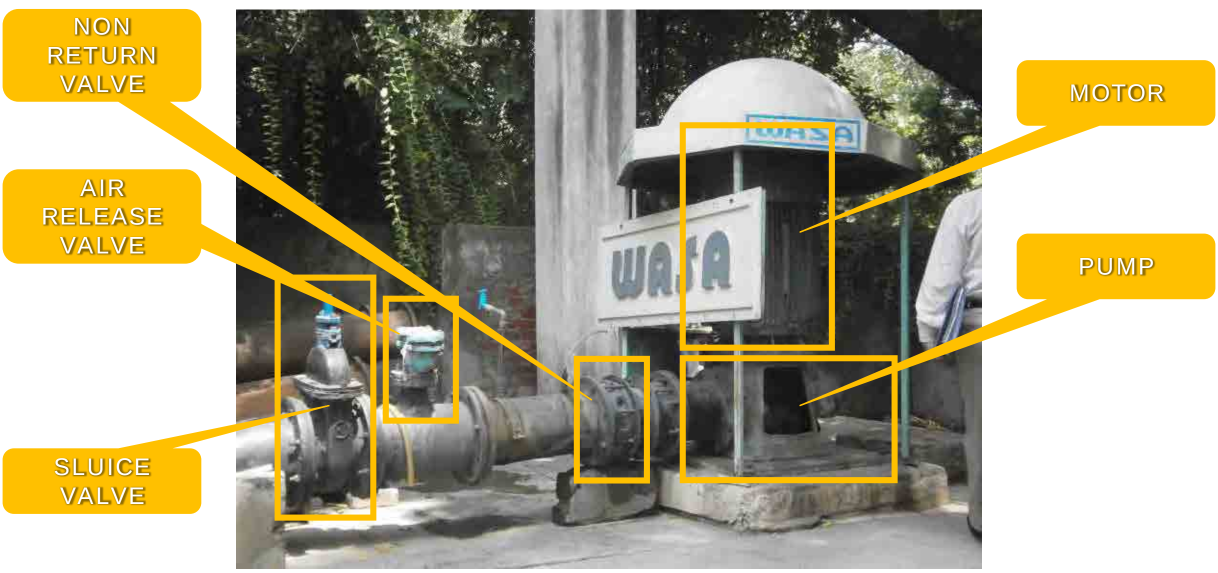
Importance of Tube Well Pumps

This could be my home !

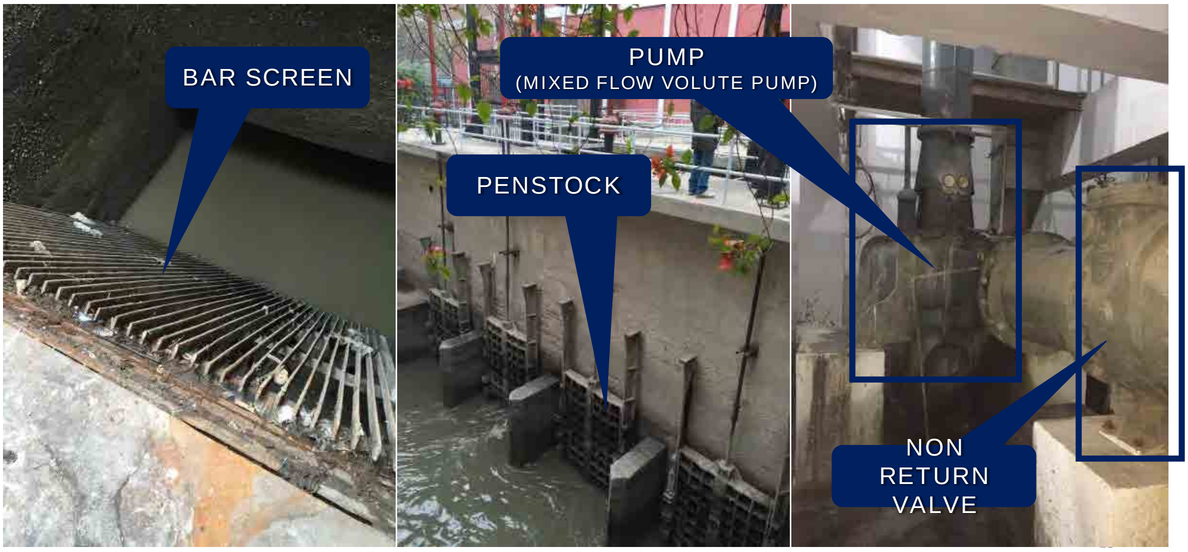
Importance of Disposal Station Pumps

This could be our children !

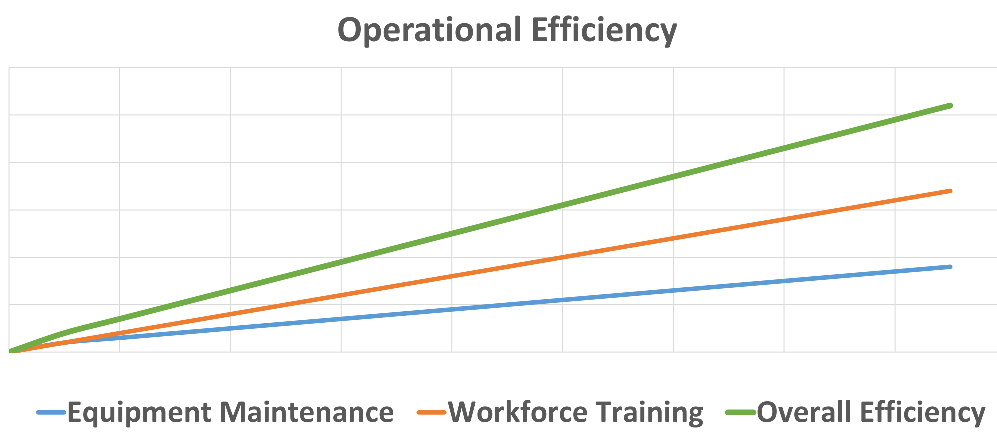
Introduction to Pumps (Tube Well)



Introduction to Pumps (Disposal Station)



Importance of Equipment Reliability and Trainings



Introduction to Pumps

Pump

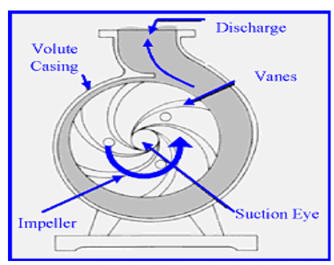
It is a mechanical device to transport liquids. It coverts kinetic energy into velocity/pressure.

Introduction to Pumps

Two major categories:

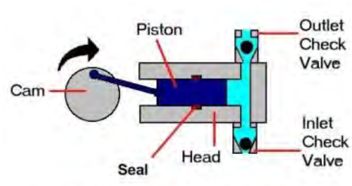
i) Centrifugal Pumps

The Pump in which energy is continuously added to increase the fluid velocities within the machine. This type is most commonly used in water and sanitation industry.



ii) Positive Displacement Pumps

The pump in which the energy is periodically added by application of force.



SINGLE ACTING RECIPROCATING

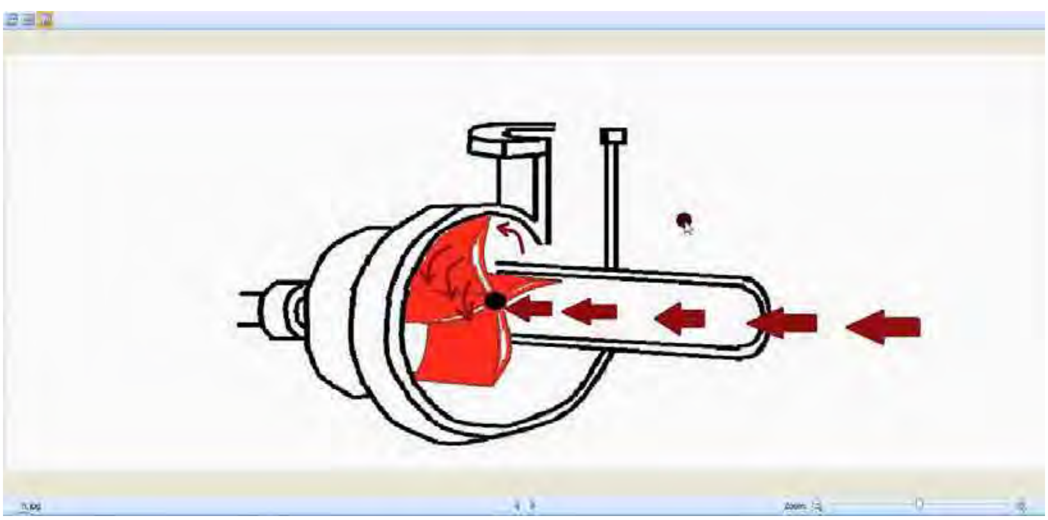
Introduction to Pumps

Centrifugal Pumps

Centrifugal pumps are used to transport fluids by the conversion of rotational kinetic energy to the hydrodynamic energy of the fluid flow. The rotational energy typically comes from an engine or electric motor.

Centrifugal Pump

Video Centrifugal Pumps



Introduction to Pumps

General Design and Parameters…

All equipment should be selected properly. Wrong selection will cause…

- ✓**Short lifecycle**
- ✓**Operational downtime**
- ✓**Energy loss**
- ✓**Major capital loss**

Selection Criteria of Pumps

How to select a pump?

How much water is needed?

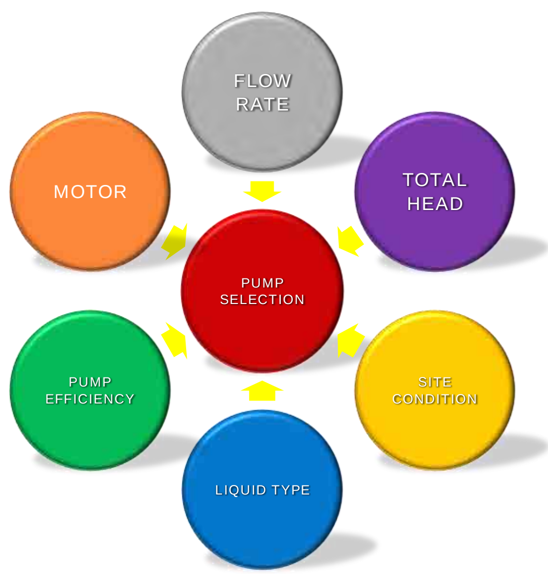
How far or high water will be delivered?

Is there a guaranteed pump efficiency need?

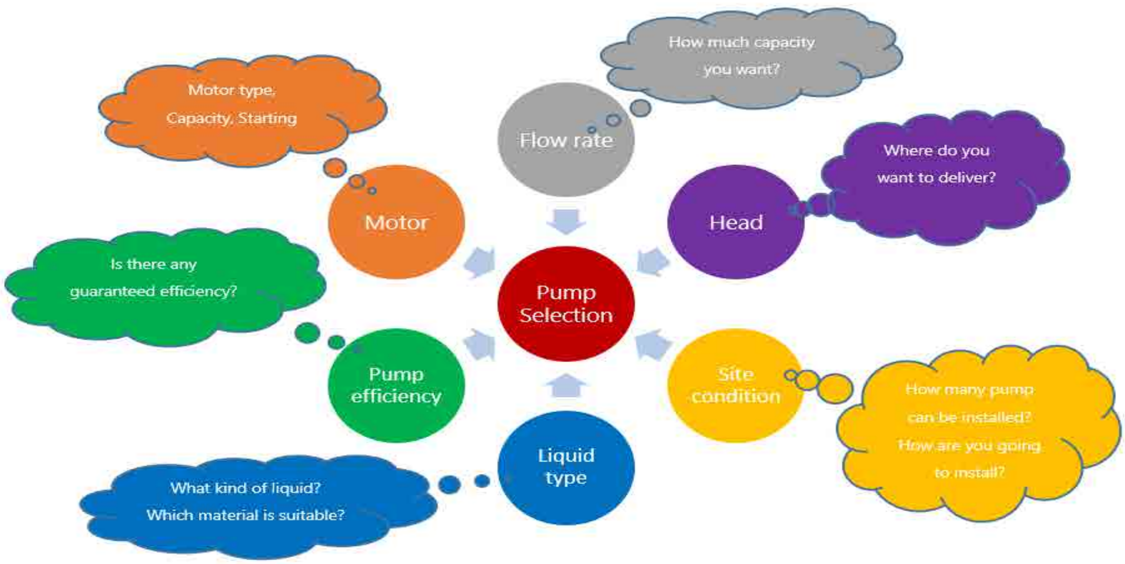
What kind of liquid is transported?

How much space is available for pump installation?

Motor/energy factor?



Selection Criteria of Pumps



Selection Criteria of Pumps

Parameters

- ✓**Flow Rate [cusec, m3/h, l/s]**
- ✓**Total Head [m, ft.]**
- ✓**Motor Output [kW, HP]**
- ✓**Pump Type [water supply, wastewater)**

Selection Criteria for Pumps

Other Parameters

- ✓ **Materials [cast iron, steel, food grade]**
- ✓ **Liquid Type [clean water, waste water]**
- ✓ **Paint [anti corrosion]**
- ✓ **Available Installation Space [m2, ft2]**

Introduction to Pump Design Basics

Pumping Concepts:

- ✓ Capacity (discharge rate required)
- ✓ Head (various)
- ✓ Pump performance curve
- ✓ Efficiency

Introduction to Pump Design Basics

Capacity

The capacity (flowrate) of a pump is the volume of liquid pumped per unit of time, which usually measured in meters per second or (gallons per minute GPM) or cusec (cubic foot per second)

In Water supply and sanitation agency,

Cusec (28.317 liters per second) is used to show the capacity of a pump.

Introduction to Pump Design Basics

Head

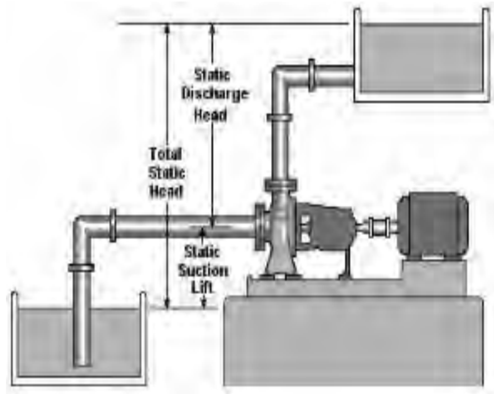
The following terms apply specifically to the analysis of pumps and pumping systems:

1) Static suction head (SSH)
2) Static discharge head (SDH)
3) Friction head
4) Velocity head
5) Total head (TH)

Introduction to Pump Design Basics

Head

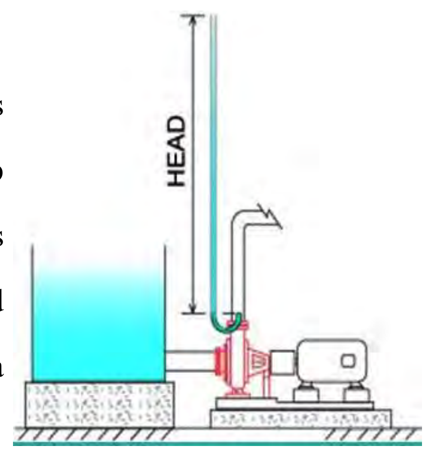
The term "head" is the elevation of free water surface of water above or below a reference datum. For example, if a small, open-ended tube were run vertically upward from a pipe under pressure, the head would be the distance from the center line of the pipe to the free water surface in the vertical tube.



Introduction to Pump Design Basics

Head

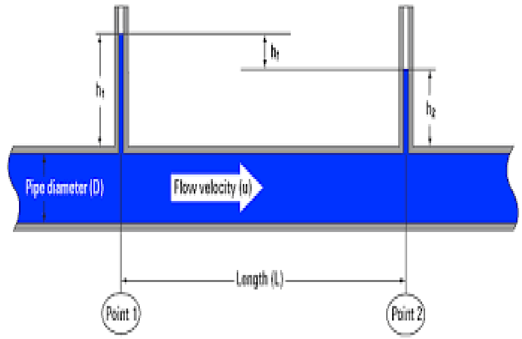
In pumping systems, the head refers to both pumps and pumping systems. The height to which a pump can raise the water is the pump head and it is measured in meters (feet) of flowing water. The head required to overcome the losses in a pipe system at a given flow rate is called the system head.



Introduction to Pump Design Basics

Friction head

The friction head is head of water that must be supplied to overcome the frictional loss caused by the flow of water through the pipe in the piping system. The friction head consists of the sum of the pipe friction head losses in the suction line and the discharge line.



Introduction to Pump Design Basics

Velocity head

The velocity head is the kinetic energy contained in the water being pumped at any point in the system as is given by:

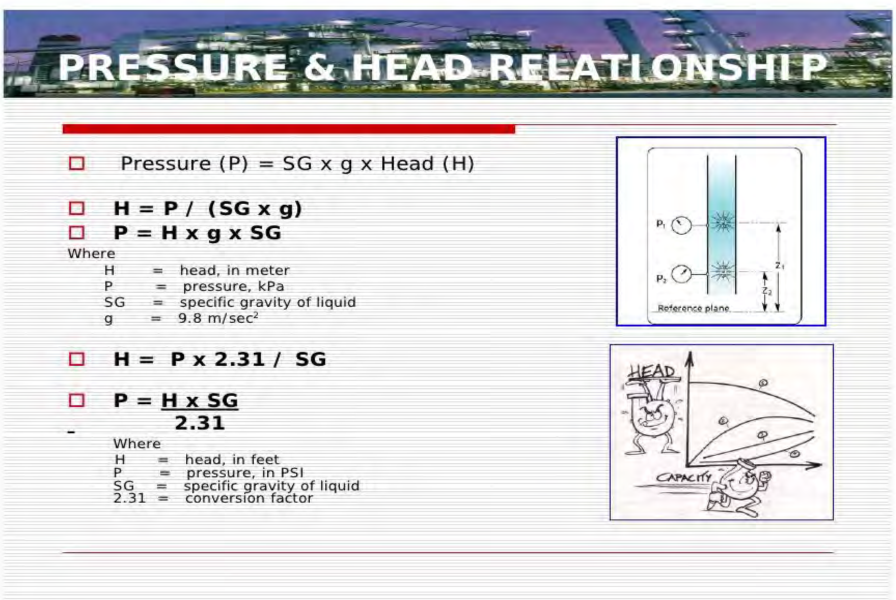
$$\text{Velocityhead} = \frac{V^2}{2g}$$

Introduction to Pump Design Basics

Total Head (TH)

Total Head, is the head against which the pump must work when the water is being pumped. The TH, can be determined by adding total static head, the frictional head loss and pump losses.

TH = TSH+FH



The below equations may be used to convert between head and pressure when those measures are in the metric units kPa and m. Gravity is measured in m/s^2.

Conversion from head to pressure:

$$P = \frac{\rho \times g \times h}{1000} = SG \times g \times h$$

Conversion from pressure to head:

$$h = \frac{1000 \times P}{\rho \times g} = \frac{P}{SG \times g}$$

Introduction to Pump Design Basics

Pump Efficiency

Pump performance is measured in terms of the capacity, which the pump can discharge against a given head and at a given efficiency. The pump manufacturer must supply design information on pump performance. Pump efficiency E_p which is the ratio of the useful output power of the pump to the input power to the pump is given by:

Introduction to Pumps Types

Pump Efficiency

$$E_p = \frac{\text{pumpoutput}}{P_i} = \frac{\gamma Q H_t}{P_i} = \frac{\gamma Q H_t}{bhp \times 550}$$

E_p = Pump efficiency, dimensionless

P_i = Power input = Motor output, kW, kN-m/s

γ = Specific weight of liquid, kN/m^3 (lb/ft^3)

Q = Capacity, m^3/s (ft^3/s)

H_t = Total dynamic head, m (ft)

bhp = Brake horsepower

550 = Conversion factor for horsepower to ft-lb/s

Introduction to Pump Design Basics

Centrifugal Pump Nameplate and Designation

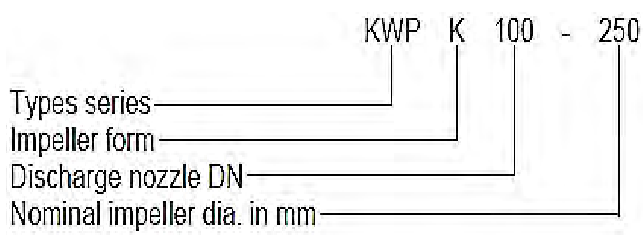
Specification:

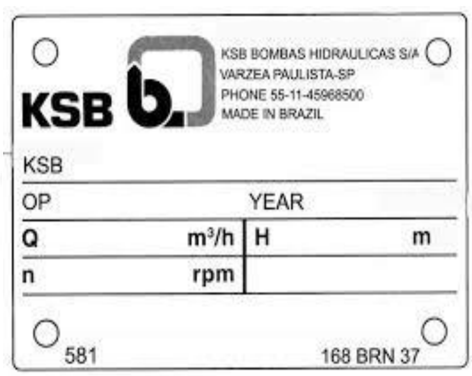
Discharge Diameter: 40--500mm(1.6--20inch)

Flow Capacity: 10--6000m^3/h

Head: 6--80m

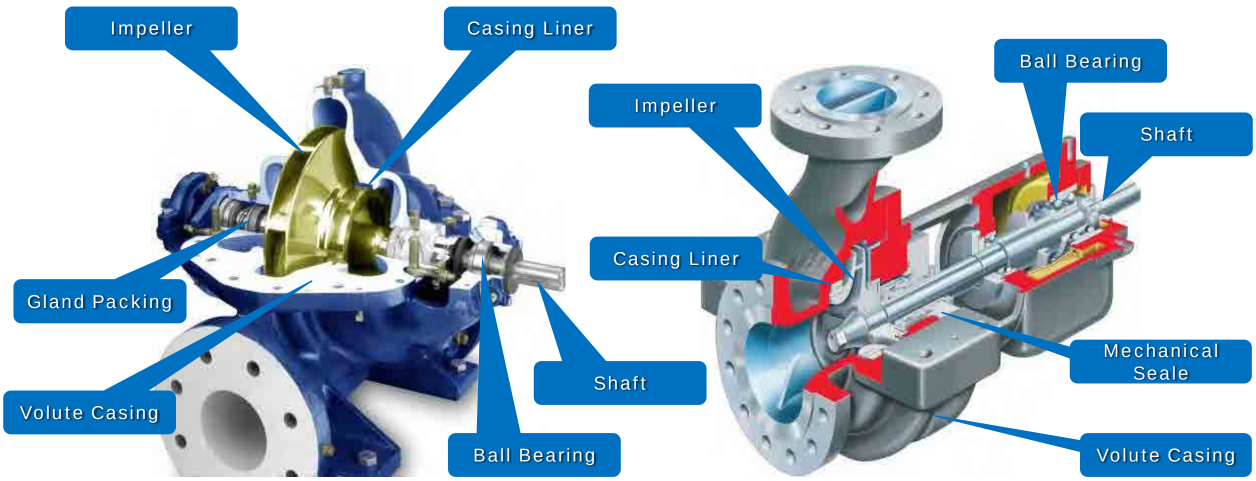
Name Plate and Designation





Assembly Parts of Pumps

Centrifugal Pump Structural Parts for Disposal Station

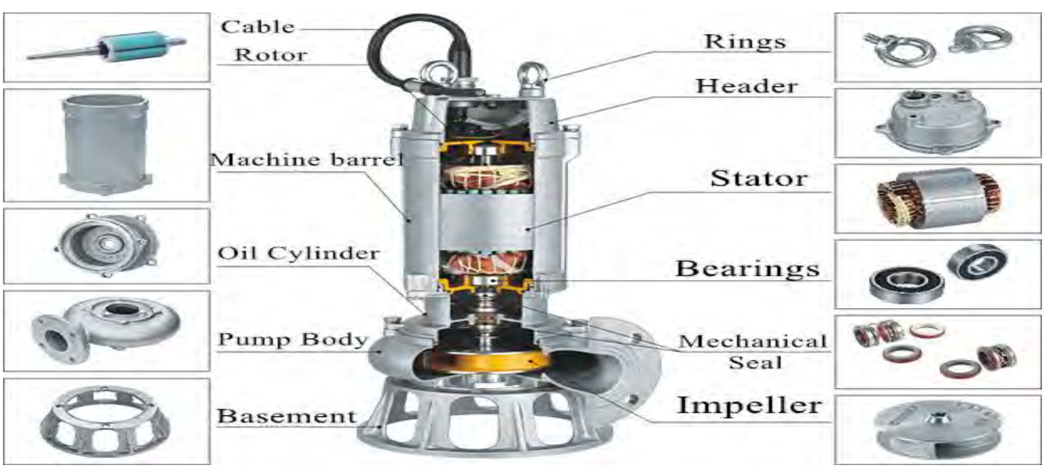


Double Suction Volute Pump

Single Suction Volute Pump

Assembly Parts of Pumps

Submersible Pump Structural Parts for Disposal Station



Pumps Operations

Centrifugal Pump Startup & Operation

- Check and remove debris from sump and pipes
- Check pump should be fully primed.
- Check valves (open)
- Check voltage range for 3-Phase motor.

Pumps Operations

Centrifugal Pump Startup & Operation

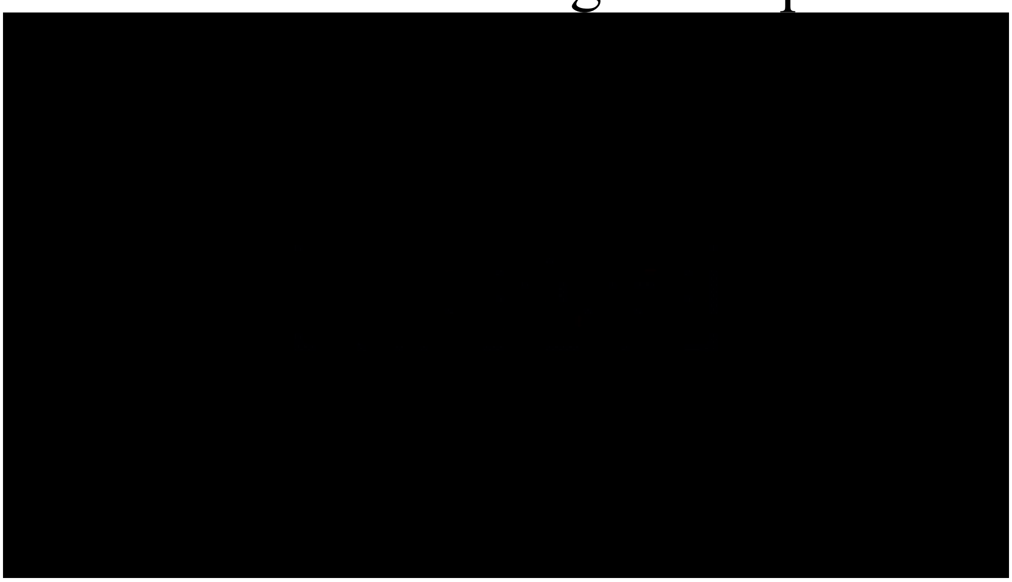
- Check that ammeter reading is less than rated motor current
- After startup check sump level (stable)
- Check for undue vibration and noise.
- After10-15 minutes, check the bearing temperature, stuffing box packing, and leakage through mechanical seal.
- Voltage should be checked every hour.

Preventive Maintenance of Pumps

Preventive Maintenance Centrifugal Pumps

- Adjustment of pump internals
- Replacement of hydraulic components
- Gland Packing Replacement
- Lubrication
- Check bearing temperature and noise.
- Record keeping

Video Centrifugal Pumps



Introduction to Pumps

Vertical Turbine Pump

These pumps are commonly used in groundwater wells. These pumps are driven by a shaft rotated by a motor on the surface

Introduction to Pumps Types

Vertical Turbine Pump

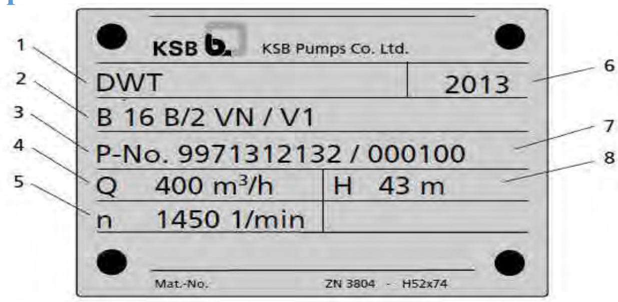
DesignationExample: B 16 B/2 VN / V1

Code	Description
B	Type Series
16	Well diameter in inches (16 = 16")
B	Hydraulic system (B impeller)
2	Number of stage of hydraulic system
VN	Type of installation (VN=Discharge nozzle above floor)
V1	Type of derive (V1= direct derive by vertical electric motor)

Introduction to Pumps Types

Vertical Turbine Pump

Name plate with description



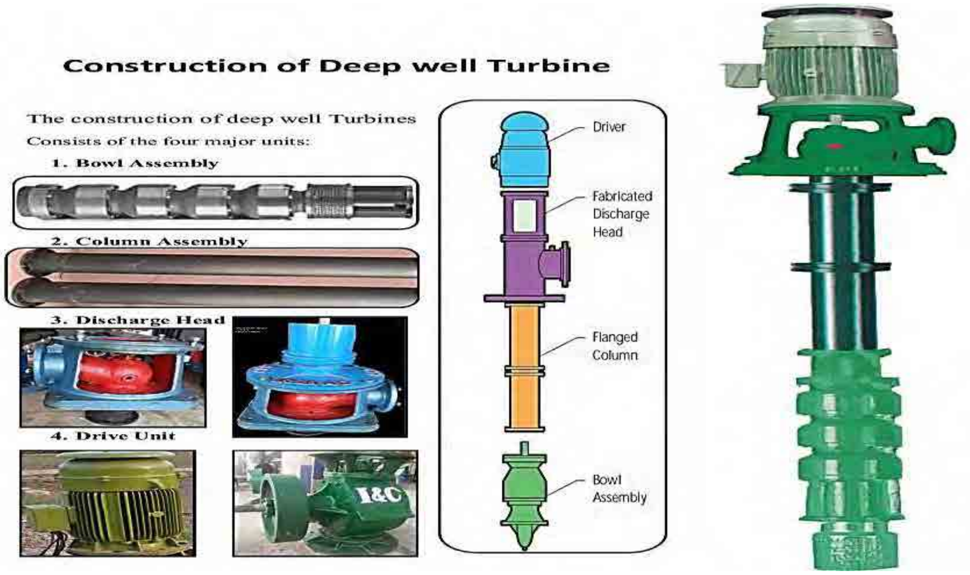
1	Pump type	2	Designation of the pump set
3	Order number	4	Flow rate
5	Speed	6	Year of supply
7	Order item number	8	Head

Introduction to Pumps Types

Submersible Pump

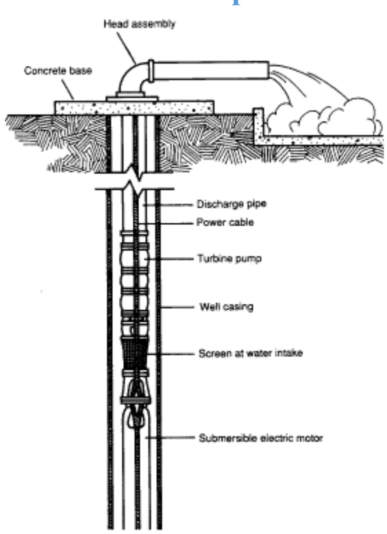
A type of pump in which the motor and pump both are in the ground water reservoir. Motor is water proof and electricity is provided to the motor by a water proof cable.

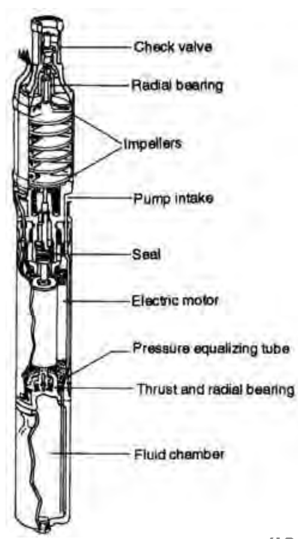
Assembly Parts of Pumps



Assembly Parts of Pumps

Structural Parts of Submersible Pump for Tube well





Comparison of Vertical pump and Submersible pump

	Vertical shaft centrifugal pump (Tube well)	Submersible motor pump (tube well)
Picture		
Bore size	Cover a wide range	Max bore: approx. 200 mm
Flow capacity	Cover a wide range	Small
Head	Cover a wide range	Cover a wide range
Efficiency	Small bore: almost equal with submersible motor pump Big bore: Max eff. approx.90%	Maximum: approx. 80%
Installation	complex	Easy
Maintenance	complex	Easy
Cost	Expensive than Submersible motor pump	Cheaper than Vertical shaft pump
Vibration/Noise	Need attention	No need to pay attention compare to Vertical pump
Leakage	Need attention	No need to pay attention compare to Vertical pump

Pumps Operations

Vertical Turbine Pump Startup & Operation

- Check pump lubricate water tank is filled and lubricate.
- Check valves (open).
- Check voltage range for 3-Phase motor.
- Check Open the air vent in discharge/delivery pipe (not standard, if air release valve is working)
- Check for proper rotation
- Check steady water stream is let out through air vent, close the air vent.
- Check that ammeter reading is less than rated motor current.

Pumps Operations

Vertical Turbine Pump Startup & Operation

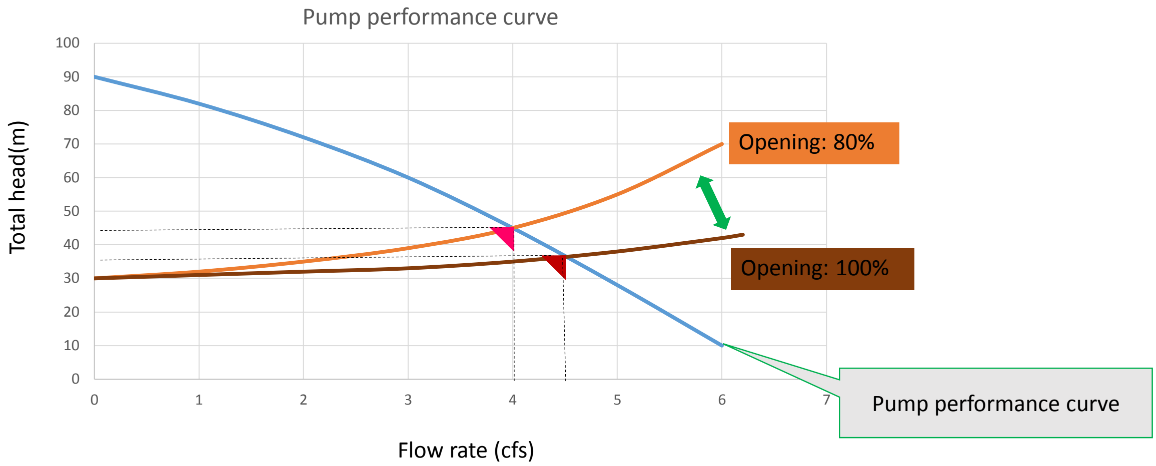
- After startup check pressure for operating point.
- Check for undue vibration and noise.
- After10-15 minutes, check the bearing temperature, stuffing box packing, and leakage through mechanical seal.
- Voltage should be checked every hour.

Pumps Operations

Submersible Pump Startup & Operation

- Check water level in bore hole.
- Check valves (open).
- Check voltage range for 3-Phase motor.
- Check that ammeter reading is less than rated motor current.
- After startup check pressure for operating point.
- Check for undue vibration and noise.
- Voltage should be checked every hour.

Pumps Performance



Preventive Maintenance of Pumps

Preventive Maintenance Vertical Turbine Pumps

- Lubricate the bearings on pumps supplied with lubrication points.
- Inspect the packing or mechanical seal
- Check for unusual noise, vibration, and bearing temperatures.
- Check the pump and piping for leaks.
- Check the source of vibrations and acceptable levels.
- Record keeping

Preventive Maintenance of Pumps

Preventive Maintenance Pumps

Stuffing-box box leaks

✓ **Normal leaks**

With the pump in operation, there should be some leaking at the stuffing box packing. The correct leak rate is a rate which keeps the shaft and stuffing box cool. Check the temperature of the leaked fluid as well as the discharge head.

✓ **Decreased leaks**

If the pump runs hot and the leaks begin to decrease, stop the pump and allow it to cool down. Loosen the packing gland in order to allow the packing to resume leaking. After pump has cooled, restart pump and run it for 15 minutes. Then check the leaks. If the leak exceeds 20 drops per min or six liters per hour adjust or change gland pack (as per KSB service department).

Regular Submersible Pump (Motor) Inspections

Frequency	Inspection Items	Remarks
Daily	1. Check for excessive vibration and strange sounds. 2. Check working order. 3. Check electric current values.	・Confirm that there are no sudden changes in current or pressure. ・Measure and record values regularly.
Monthly	1. Measure Insulation resistance. 2. Measure continuity.	・Check insulation resistance lower limits.
Annual	1. Check protective equipment (thermal protectors, flood detectors etc.) status. 2. Inspect appearance.	・Confirm their continuity. ・Pull the pump and check for any damaged parts
Every 2-3 Years	1. Overhaul and service unit.	・Replace any worn parts.(mechanical seals, bearings) ・Confirm any repair any wear, Deformities, corrosion, or faulty parts.

Notes: Inspect the unit everyday if it is used 2,000 hours or more consecutively in one year. The frequency of overhauls varies according to the amount of use.

Troubleshooting

Trouble shooting Pumps

1. Troubles are of 3 types: mechanical, hydraulic and motor related
   - ✓ Mechanical troubles: Breakage of coupling or shaft
   - ✓ Hydraulic troubles: Failure to deliver water, reduction in discharge and over loading.
   - ✓ Motor troubles: If conditions change, adjustments in pump speed and/or impeller diameters may require changes.
2. Flow rate increases – check if system head decreased, is motor tripping on overloading?

.

Troubleshooting

Trouble shooting Pump

3. Flow rate decreased – check if system head is increased, obstruction in pipe, worn impeller, check pump speed is as specified.
4. Vibrations – check obstruction in suction, cavitation, impeller with solid particle logged in vane, system alignment (shaft, coupling etc.), tightening of installation bolts
5. Seal leakage – while running or at shut down? – check suction conditions, wear in parts, pump speed, changes in system.

Troubleshooting

Trouble shooting Centrifugal Pump

No liquid delivered

- Lack of prime
- Speed of electric motor or engine too low
- Discharge head too high
- Suction lift too high
- Impeller plugged
- Vapor lock in suction line

Troubleshooting

Trouble shooting Centrifugal Pump

Not enough water discharge

- Air leaks
- Worn wearing rings
- Damaged impeller
- Defective foot valve
- Worn gaskets

Troubleshooting

Trouble shooting Centrifugal Pump

Overloading of Motor / Engine

- Low discharge head
- Packing too tight
- Bent shaft
- Distorted casing
- Pump speed too high

Troubleshooting

Trouble shooting Vertical Turbine Pump

1. If conditions change, adjustments in pump speed and/or impeller diameters may require changes.
2. Flow rate increases – check if system head decreased, is motor tripping on overload?
3. Flow rate decreased – check if system head is increased, obstruction in pipe, worn impeller, check pump speed is as specified.

Troubleshooting

Trouble shooting Vertical Turbine Pump

4. Vibrations – check obstruction in suction, impeller with solid particle logged in vane.
5. There is excessive leakage from the stuffing box – The packing is defective. Replace any packing that is worn or damaged

Troubleshooting

Trouble shooting Submersible Pump

1. If conditions change, adjustments in pump speed and/or impeller diameters may require changes.
2. Flow rate increases – check if system head decreased, is motor tripping on overload?
3. Flow rate decreased – check if system head is increased, obstruction in pipe, worn impeller, check pump speed is as specified.

Troubleshooting

Trouble shooting Submersible Pump

4. Vibrations – check obstruction in suction, impeller with solid particle clogged in vane.
5. Sand in well discharge and/or excessive pump impeller wear

Possible problem	**Solution**
Damaged well screen or gravel envelope	In some cases a drilling contractor may be able to replace or repair the screen or gravel envelope.
Flow is drawing sand into the well	Throttle back the flow rate to reduce the problem. A drilling contractor may also need to redevelop the bore to flush out the sand around the bore screen (or take other measures as appropriate).

Troubleshooting

Trouble shooting Submersible Pump

Possible problem	**Solution**
Rapid stop/start pumping agitating the bore and not flushing out the sand	Look at the pump controls. Install storage or a variable speed drive (not always appropriate).

Motor Size Calculation

Shaft Power Calculation

Pump efficiency (η):

Pump efficiency is different depending on the operating point, pump type, and capacity etc. Pump is operated high efficiency point, energy and cost consumption can be suppressed. Therefore, pump user should select highest pump efficiency point at the pump operation point as well as possible.

Motor Size Calculation

Liquid power (L_w):

The effective energy given to a liquid by a pump in a unit of time, expressed by the following equation.

$$L_w = \rho g Q H / 1{,}000 \text{ (kW)}$$

Where L_w : Liquid power $[kW]$

ρ : Liquid density $[kg/m^3]$

Note: In case of tube wells, the density is almost 1,000 kg/m^3

g : Gravity accelaration $[m/s^2]$

Note: Gravity acceleration on the Earth is almost 9.8 m/s^2

Q : Capacity $[m^3/s]$

H : Total head [m]

Motor Size Calculation

Shaft power (L):

The necessary power that a pump transports liquid to required destination (height, distance) is called SHAFT POWER and expressed by the following equation. Shaft power is used for motor selection.

$$L = L_w / \eta \text{ (kW)}$$

$$L = \rho g Q H / \eta \text{ (kW)}$$

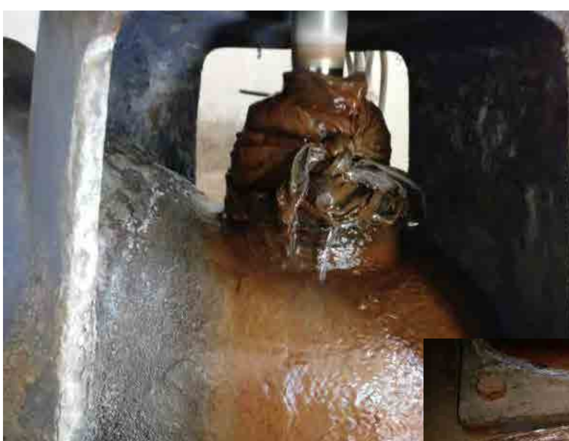
$$L = 0.75 \times \rho g Q H / \eta \text{ (PS)}$$

Power output determination

Driver power output is decided by calculating the shaft power and by considering shaft power allowance rate, expressed by the following equation.

$$P = L(1 + \alpha)$$

Suggested Improvement



Suggested Improvement

Suggested Improvements

Suggested Improvements

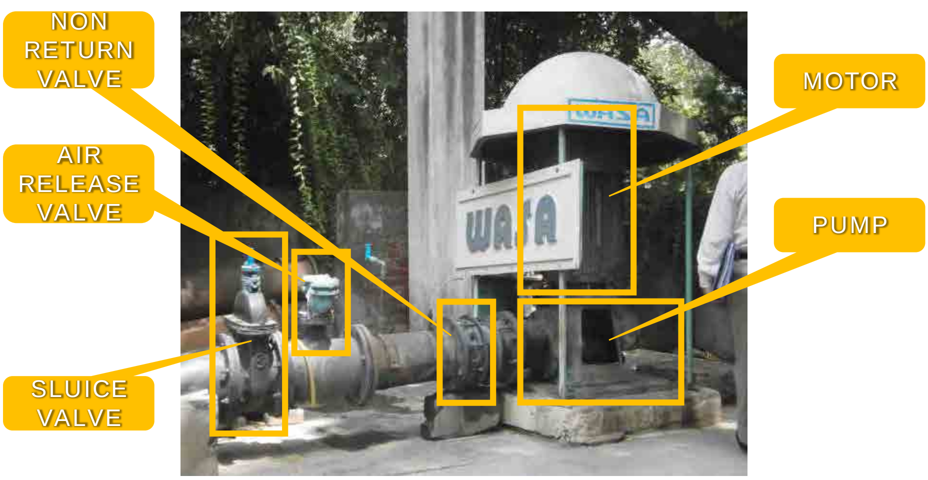
Suggested Improvements

Suggested Improvements

Current Conditions

Suggested Improvement

Current Conditions



Suggested Improvement

Suggested Improvement

Things to remember !!!

- ✓ Follow SOPs

O & M of Mechanical Equipment
WSD 5231

Module 1

Valves

Icebreaker and Class Introduction

- Importance of Valves in WASA operations
- What do we cover in this module?
- What to expect in this module?
- Goal and objectives of this module?

Agenda

- ✓ Ice Breaker and class introduction
- ✓ Resources and handouts
- ✓ Introduction and selection of valve
- ✓ Assembly parts of valves

Agenda

- ✓ Valve operations
- ✓ Preventive maintenance of valves
- ✓ Troubleshooting of valves

Icebreaker and Class Introduction

Now it is your turn…

- Degree and backgrounds?
- Share your work experience relative to Valves?

Resources and Handouts

- MANUAL OF WATER SUPPLY PRACTICES—M44, Second Edition Distribution Valves: Selection, Installation, Field Testing, and Maintenance AWWA(2006)
- Pumps and Pumping (Arasmith, S. 2006) ACR Publications, London

Resources and Handouts

- Participant lecture notes, Module 1
- Class presentations, Module 1
- O and M of Valves Manual
- JICA, Manual on sewerage and sewage treatment, Part B: Operation and Maintenance, Ministry of Urban Development, New Delhi

Introduction and selection of valves

Valve

A valve is a device that regulates, directs or controls the flow of a fluid by opening, closing, or partially obstructing various passageways.

Valve Functions

- ✓ Stopping and starting fluid flow.
- ✓ Varying (throttling) the amount of fluid flow.
- ✓ Controlling the direction of fluid flow.
- ✓ Regulating downstream system or process pressure.
- ✓ Relieving component or piping pressure.

Introduction and selection of valves

Classification of Valves

The following are some of the commonly used valve classifications, based on mechanical motion:

Linear Motion Valves.

The valves in which the closure member, as in gate or sluice, moves in a straight line to allow, stop, or throttle the flow.

Introduction and selection of valves

Classification of Valves

Rotary Motion Valves.

When the valve-closure member travels along an angular or circular path, as in butterfly valves.

Quarter Turn Valves.

Some rotary motion valves require approximately a quarter turn, 0 through 90°, motion of the stem to go to fully open from a fully closed position or vice versa.

Introduction and selection of valves

Classification of valves based on motion

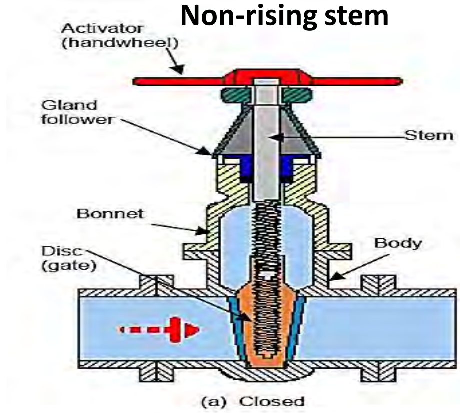
Valve types	Linear motion	Rotary motion	Quarter turn
Gate Valve	x		
Air release valve	x		
Butterfly valve		x	x
Non-return valve		x	x
Flap valve		x	

Assembly parts of valves

Basic Parts of the valve

- Body
- Bonnet
- Trim (internal elements)
- Actuator (Handwheel)
- Packing

Non-rising stem



Assembly parts of valves

Basic Parts of the valve

Bonnet

The cover for the opening in the valve body joint.

Bonnets Features

- Bonnet is the second principal pressure boundary of a valve.
- It is cast or forged of the same material as the body and is connected to the body by a threaded, bolted, or welded

Bolted Bonnet

Assembly parts of valves

Basic Parts of the valve

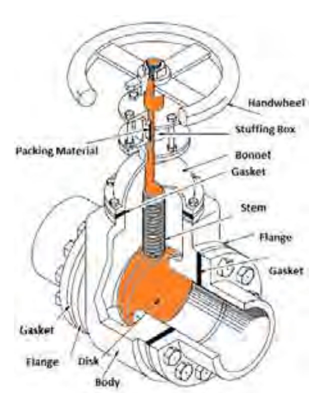
Body

It is called the shell, is the primary pressure boundary of a valve. It serves as the principal element of a valve assembly because it is the framework that holds everything together.

Introduction and selection of valves

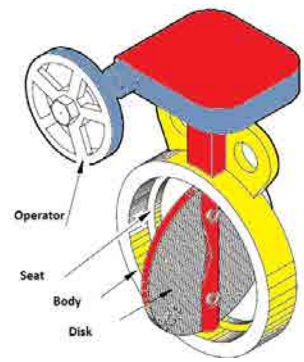
Methods of controlling flow through a valve.

1. Slide a flat, cylindrical, or spherical surface across the orifice.



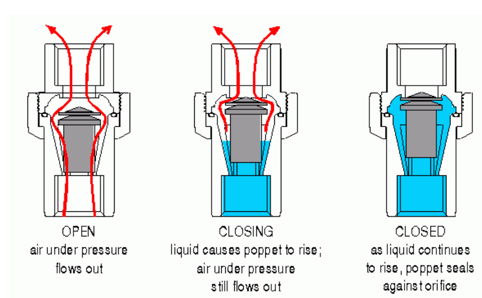
Gate valve

2. Rotate a disc or ellipse about a shaft extending across the diameter of an orifice.



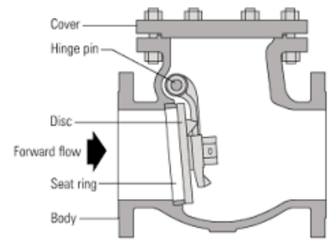
Butterfly valve

3. Ball linearly moves upwards to close of an orifice.



Air release valve

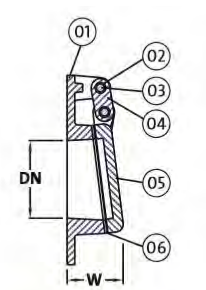
4. Non return valve rotates a disc to stop the backflow of the fluid



Non return valve

5. Flap valve rotates a cover disc to hinder air suction and backflow of the fluid. Installed at the open end of discharge pipe.

Item	Description
01	Body
02	Bush
03	Hinge pin
04	Links
05	Flap
06	Seating face



Flap valve

Valve Type and Material Selection

Selection Consideration

1. **Pressure**

2. **Temperature**

3. **Type of fluid**

    A. Water

    B. Wastewater (corrosive)

    C. Water with sand (abrasive)

4. **Flow Considerations**

    A. On-off or Throttling

    B. To prevent backflow

    C. Concern for pressure drop

    D. Velocity

    E. Flow resistance

5. **Operating conditions**

    A. Frequency of operation.

    B. Accessibility.

    C. Overall space/size available.

    D. Manual or automated control.

    E. Need for bubble-tight shut-off.

    F. Concerns about body joint leaks.

    G. Fire safe design.

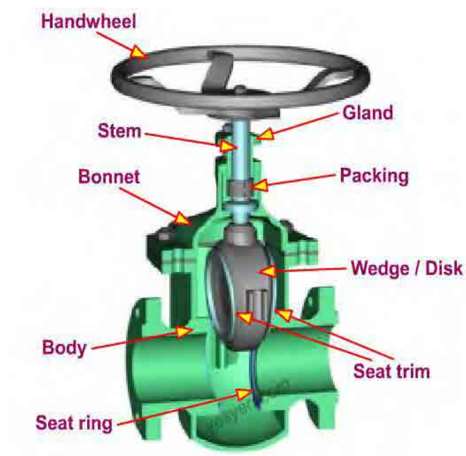
    H. Speed of closure.

Introduction and selection of valves

Valve Types

Gate Valves

Flow is controlled by raising or lowering the disk. Gate valves are not usually used to regulate flow because the valving element can be damaged when in the partially open position. Similarly, they also limit the pressure drop across the valve when fully open.



Introduction and selection of valves

Valve Types

Gate Valves

Advantages

- Gate valves opens or closes slowly, which prevents fluid hammer and
- Subsequent damage to the piping system.
- They need long operation time since setting the valve to the fully open or closed position requires the handle to be turned many times.
- Good choice for on-off service.
- Full flow, low pressure drop.
- Bidirectional.

Introduction and selection of valves

Valve Types

Gate Valves

Disadvantages

It is not suitable for throttling applications.

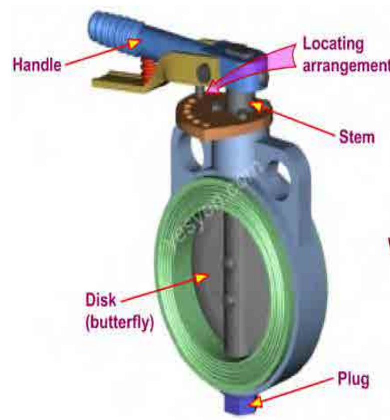
- It is prone to vibration in the partially open state.
- It is more subject to seat and disk wear.
- Repairs, such as lapping and grinding, are generally more difficult to accomplish.

Introduction and selection of valves

Valve Types

Butterfly Valves

Butterfly valves are rotary motion valve that is used to stop, regulate, and start fluid flow.



Introduction and selection of valves

Valve Types

Butterfly Valves

Advantages

- They are suitable for large valve applications.
- Compact, lightweight design.
- The maintenance costs are usually low.
- Pressure drop across a butterfly valve is small.
- Used with chemical or corrosive media.

Introduction and selection of valves

Valve Types

Butterfly Valves

Disadvantages

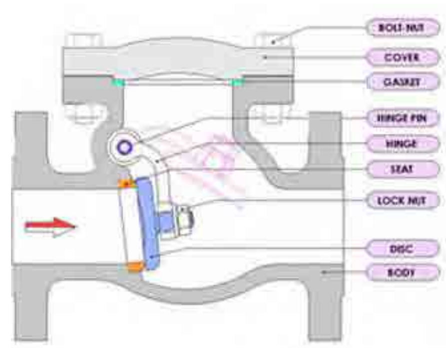
- Difficult to clean
- Throttling limited to low differential pressure
- Potential for cavitation and choke
- Unguided disc movement is affected by flow turbulence

Introduction and selection of valves

Valve Types

Check or Non return valve

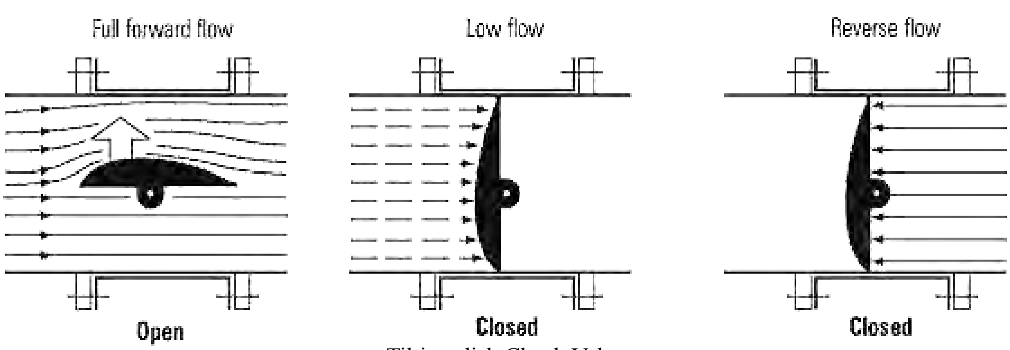
Check valves are designed to prevent the reversal of flow in a piping system. These valves are activated by the flowing material in the pipeline. The pressure of the fluid passing through the system opens the valve, while any reversal of flow will close the valve.



Introduction and selection of valves

Valve Types

Check or Non return valve



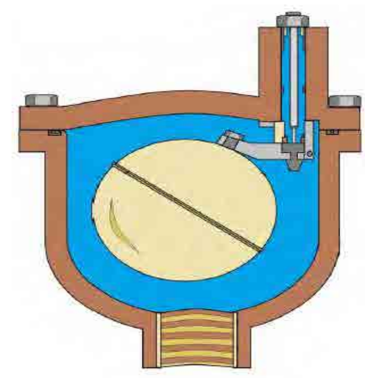
Tilting-disk Check Valve

Introduction and selection of valves

Valve Types

Air Release Valves

An air release valve is generally a self-actuated valve that automatically vents small pockets of air that accumulate at the high point in a water distribution system when the system is operating under pressure.



Introduction and selection of valves

Valve Types

Air Release Valves

Advantages

- Air release valves protect the pipeline system and maintain its efficiency.
- These valves are perfect for quickly venting large volumes of air during filling or startup.
- This is important because some pipe materials can collapse under negative pressure.

Introduction and selection of valves

Valve Types

Air Release Valves

Advantages

- Once an air release valve is installed, it constantly operates automatically.

Disadvantages

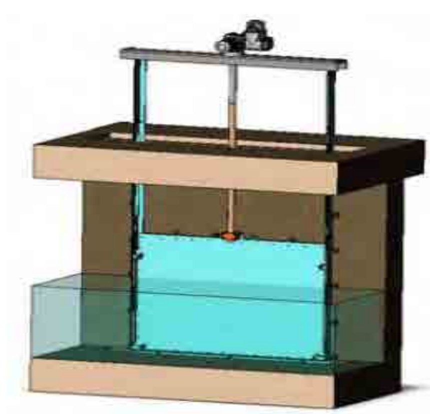
- If a pipeline is filled or emptied too quickly, an air release valve does not always keep up with the air flow demands.
- You must size the valve correctly for your application.

Introduction and selection of valves

Valve Types

Penstock Valve

A penstock is a sluice or gate or intake structure that controls water flow, or an enclosed pipe that delivers water to hydro turbines and sewerage systems



Valves operations

Guidelines to close a valve

Crews should follow the following guidelines to close a valve properly:

1. Begin with a steady amount of torque in the direction necessary to close the valve, moving through 5 to 10 rotations.
2. Reverse for two or three rotations.
3. Reverse again and rotate 5 to 10 more turns in the closing direction.
4. Repeat this procedure until full closure is attained.

Valves operations

Guidelines to close a valve

5. Once the valve is fully closed, it should be opened a few turns so that high- velocity water flowing under the gates can move the remainder of the sediment downstream with more force and clear the bottom part of the valve body for seating.
6. Fully close the valve again.

Causes of Debris and Sediment valve

- If cautious approach is not apply than debris and sediment often build up on the gates, stem, and slides.
- If this material is compacted while the valve is being closed, the torque required to close the valve continues to build as the material is loaded.
- If the procedure previously described is used, the stem and other parts are "scrubbed" by the series of back-and-forth motions, and water in the system can flush the debris that has broken loose away from the stem gate and slides or guides.

Preventive maintenance of valves

Valve Maintenance Procedures

- A valve that has not been operated for a number of years needs to be closed by using a series of up and down motions.
- Crews attempting to close a difficult valve should never use a T-handle and extension to force the valve closed.
- Such over torque to obtain a positive shutoff can cause damage to the valve.

Preventive maintenance of valves

Valve Maintenance Procedures

- Torque- limiting devices are available.
- Gland pack leakage check and replacement
- Proper lubrication
- If possible use SS bolts

O & M of Mechanical Equipment
WSD 5231

Chlorination and Filtration System

Module 2

Agenda

- ✓ Ice Breaker and Class Introduction
- ✓ Resources and handouts
- ✓ Introduction to chlorination and filtration systems and assembly parts.

Agenda

- ✓ Importance of Chlorination and Filtration System in WASA operations
- ✓ Dosage calculation in chlorination systems and WHO guidelines.
- ✓ Operation of chlorination and filtration system.
- ✓ Preventive maintenance

Icebreaker and Class Introduction

- What do we cover in this module?
- What to expect in this module?
- Goal and objectives of this module?

Icebreaker and Class Introduction

Now it is your turn…

- Degree and backgrounds?
- Share your work experience relative to Chlorination and Filtration System?

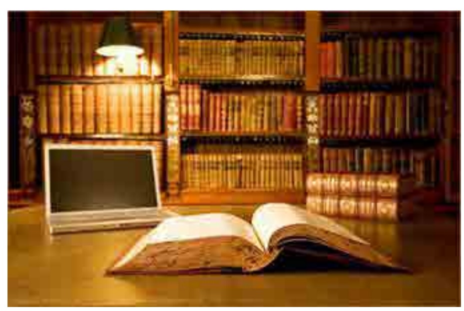
Icebreaker and Class Introduction

Now it is your turn…

- Any prior experience on Chlorination and Filtration System?
- Why interested in this module?
- What best skills do you bring to the class?

Resources and Handouts

- Owner's Manual, KSB Filtration system
- Pumps and Pumping (Arasmith, S. 2006) ACR Publications, London
- O and M of Chlorinator feed pump Manual
- Participant lecture notes, Module 4
- Class presentations, Module 4



Introduction to Chlorination and Filtration Systems

Chlorine Disinfection (Chlorination)

Chlorination is the addition of chlorine to water to make it safe for human consumption. Chlorine (and its compounds) is the most widely used disinfectant for water systems because of its effectiveness, economy and ease of application.

Introduction to Chlorination

Chlorine Disinfection (Chlorination)

- Chlorination has the advantage of **oxidizing bacteria and virus** even after the point of application due to its residual action.
- If any bacteria introduced to the system after the point of chlorination can still be eliminated by the **residual chlorine** in the water.

Introduction to Chlorination

Chlorine Disinfection (Chlorination)

There are two type of chlorinator which is used in WASA

1. Hypo Chlorinator

2. Drip Type Chlorinator

Introduction to Chlorination

Chlorine Disinfection (Chlorination)

1. Hypo-chlorinator

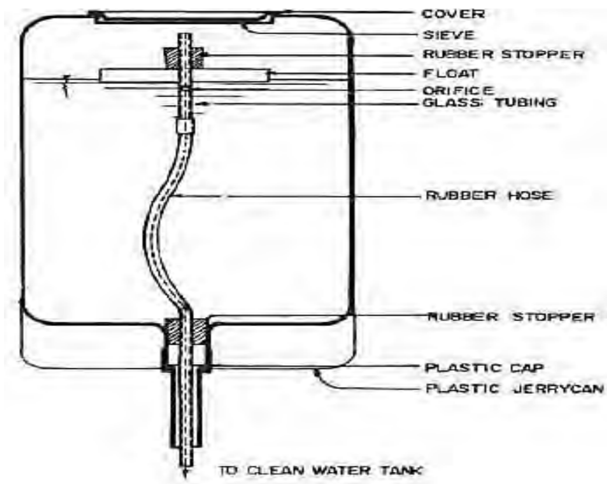
The hypo-chlorinator is a pump used to add hypochlorite solutions to water at a manually adjustable feeding rate. Pump draws the hypochlorite solution from a container and transfers it into the water for treatment.

Introduction to Chlorination

Chlorine Disinfection (Chlorination)

1. Drip-type chlorinator

A drip-type chlorinator can be used for disinfecting small reservoirs, wells and cisterns.



Introduction to Chlorination

Chlorine Disinfection (Chlorination)

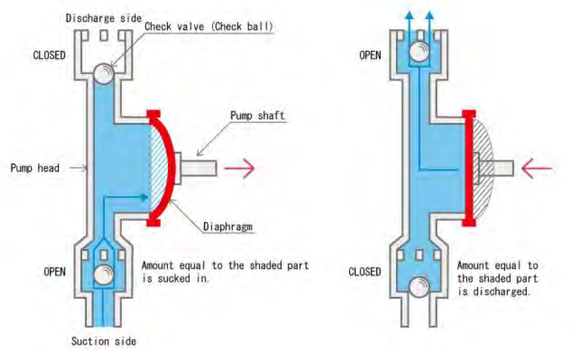
Diaphragm pump in chlorinator

A diaphragm pump (also known as a Membrane Pump) is a positive displacement pump that uses a combination of the reciprocating action of a rubber, thermoplastic or Teflon diaphragm and suitable valves.

Introduction to Chlorination

Chlorine Disinfection (Chlorination)

Flow Diagram of Diaphragm Pump



Introduction to Chlorination

Chlorine Disinfection (Chlorination)

Diaphragm pump characteristics:

- Have good suction lift characteristics, some are low pressure pumps with low flow rates; others are capable of higher flow rates, dependent on the effective working diameter of the diaphragm and its stroke length.

Introduction to Chlorination

Chlorine Disinfection (Chlorination)

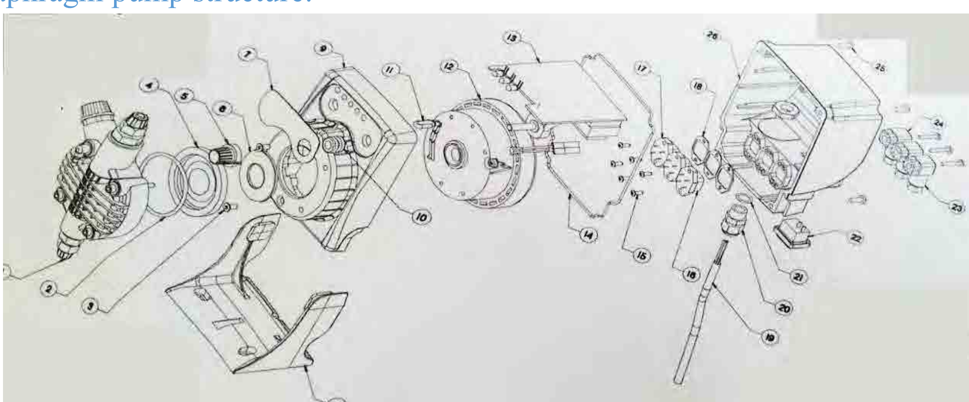
Diaphragm pump properties:

- Suitable for discharge pressure.
- Have good dry running characteristics.
- Also used to make air pumps for the filters on small fish tanks.
- Have good self priming capabilities.
- Can handle highly viscous liquids.

Assembly components of Chlorination

Chlorine Disinfection (Chlorination)

Diaphragm pump structure:



Structure of Diaphragm Pump

Assembly components of Chlorination

Chlorine Disinfection (Chlorination)

Diaphragm pump Names of Parts:

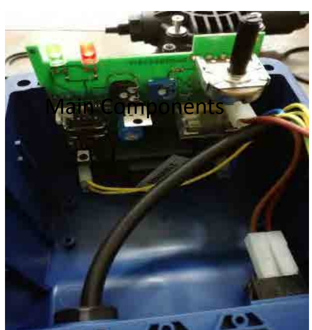
S.No's	Names of Parts	S.No's	Names of Parts	S.No's	Names of Parts
1	Pump Head	10	Potentiometer Gasket	19	Power Cable
2	Pump Head O-ring	11	Thermostat	20	Cable Clamp
3	Electromagnet screw	12	Electromagnet	21	Cable Clamp O-Ring
4	PTFE Diaphragm	13	PC Board	22	Switch
5	Pulse Adjusting Knob	14	Back Cover Gasket	23	Output Connector
6	Flange	15	Connector Screw	24	Power Supply
7	Control Panel Serigraphy Film	16	Output Connector(Male)	25	Back Cover Screw
8	Bracket	17	Power Supply Connector(Male)	26	Back Cover
9	Casing	18	Connector Gasket		

Assembly components of Chlorination

Chlorine Disinfection (Chlorination)

Diaphragm pump Main Components:


Main Component



Control Unit


Pump
Head O-ring

Assembly components of Chlorination

Chlorine Disinfection (Chlorination)

Diaphragm pump Main Components:

PTFE Diaphragm

Main component

Assembly components of Chlorination

Chlorine Disinfection (Chlorination)

Diaphragm pump Main Components:

Thermostat/Electromagnet

Head,Drain,suction,Discharge points

Assembly components of Chlorination

Chlorine Disinfection (Chlorination)

Diaphragm pump Main Components:

PTFE (polytetrafluorethylene)

It is a thermoplastic polymer with superior chemical resistance. The PTFE pump will handle even the most aggressive acids, for instance concentrated nitric acid. Maximum liquid temperature is up to 100°C.

PTFE

Assembly components of Chlorination

Chlorine Disinfection (Chlorination)

Diaphragm pump Main Components:

Non Return Valve

A valve which can allow the water to flow only in one direction its used in suction and discharge side of the diaphragm pump. In diaphragm pump its made up of rubber material its just open when dosing the chlorine and then close.

Non Return Valve

Assembly components of Chlorination

Chlorination system used in WASA tube well

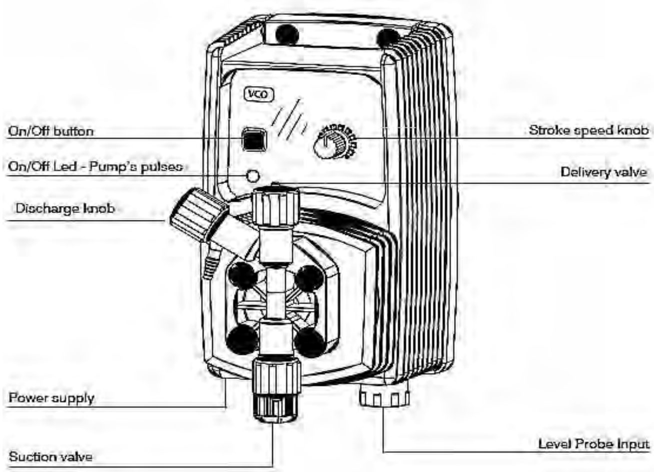
WASA use different types feed pumps for chlorine supply, most common are

a) EMEC V Pump

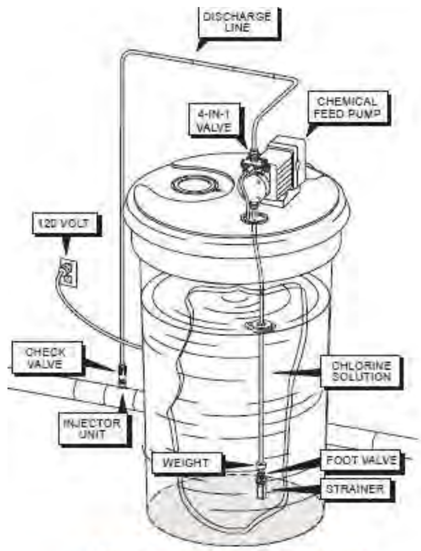
b) CHEM TECH Pump

Assembly components of Chlorination

a) EMEC V Pump Assembly Components



Components of tube well chlorination system



Typical hypochlorination feed equipment

SOPs for Chlorinator

- Check the sodium hypochlorite level in the tank
- Connect the pipe connection with drain to remove all the water or any chemical which is inside the pump and pipe.
- Set the knob for discharge or pulse stroke as per sodium hypochlorite percent discharge requirement (i.e. WASA Lahore uses 18 %)
- Turn on the diaphragm pump.
- Check if there is need to adjust the chlorinator discharge based upon actual tube well water flow rate

WASA related info

- In WASA's system chlorine inject directly at tube well system
- The Direct injection of chlorine to tube well pump may cause damage to the metal parts of tube well
  (use of drip type)

Quantity of Chlorine Used

- Sodium Hypo-chlorite solution is used.
- WASA Lahore 1ppm.
- WASA Gujranwala 0.6-0.8 ppm.
- WASA Rawalpindi 1-2ppm.
- WASA Multan 0.5ppm.
- WASA Faisalabad Ground Water 2ppm and for surface water 1.25ppm But pressurized chlorine gas used.

Dosing of Chlorine in WASA system

Periodic Maintenance for Chlorinator

Check once a month:

- ✓ Pump discharge knob position
- ✓ Strainer cleaning
- ✓ Suction and discharge pipe clogging
- ✓ Drain clogging

Check once a year:

- ✓ Non-return valve (both suction and discharge) clogging or breakage, condition of diaphragm (you will need to open the pump)
- ✓ Verify pump discharge rate by use of a metered collection tube

Troubleshooting for Chlorinator

The Metering Pump gives Pulses but the additive is not injected

a.

Check Valve

- Dismount the suction and discharge valves, clean them and replace.
- Should the valves be swollen or have cracks, replace them with standard valves by the manufacturer

Troubleshooting for Chlorinator

The Metering Pump gives Pulses but the additive is not injected

b.

Check Clogging of the filter

Check clogging of the filter.

Attention:

When removing the metering pump from the plant, be careful as there might be some residual additive in the discharge hose.

Check the Clogging in filter

Troubleshooting for Chlorinator

Electrical Faults for Chlorinator EMEC V Pump

1. All LEDs off, The Pump does not pulse

Check power supply(Socket, plug, power switch on). If the pump does not work contact manufacturer customer service, dealer or distributor.

2. Green LED(Power) On, Red LED(Pulse) off,

The pump does not pulse. Check flow rate adjustment knob(4),turning it to max flow rate. If the pump does not work contact manufacturer customer service, dealer or distributor.

Pulse Knob, Electrical Connections

Troubleshooting for Chlorinator

Electrical Faults for Chlorinator EMEC V Pump

3. Pump Pulses are not constant

Check that supply voltage is within +/- 10% of rated voltage.

4. The Dosing pump gives only one pulse

Disconnect the equipment and contact manufacturer customer service, Dealer or distributor.

Water Quality WHO guidelines.

Sr. NO.	*CHEMICAL & PHYSICAL TEST*	*GUIDELINE*	*RESULT*
1	Temperature.	-----------------	
2	pH.	6.5----------8.5	
3	Adour.	Unobjectionable	
4	Colour.	5---------50 TCU	
5	Taste.	Unobjectionable	
6	Turbidity	0--------5 NTU	
7	Clay/Sand/Rust.	Absent.	
8	Conductivity. µs/cm	------------------	
9	Total Dissolved Solid. mg/L	1000	

Sr. NO.	CHEMICAL & PHYSICAL TEST	GUIDELINE	RESULT
10	Total Hardness. mg/L	150-------500	
11	Calcium. mg/L	75--------200	
12	Magnesium. mg/L	30---------150	
13	Alkalinity. mg/L	-	
14	Chloride. mg/L	250	
15	Nitrites.	-	
16	Nitrates. mg/L	0-------------45	
17	Carbonates. mg/L	-	
18	Bicarbonates. mg/L	-	
19	Fluorides. mg/L	0------1.5	

WASA Chlorination practice

Presently WASA use Chlorination by outsourcing Sodium hypochlorite solution

- **No SOP for chlorination is available with WASA**
- **19.9 – 19.5 mg/*l* Sodium Hypochlorite Solution is available**
- **Main store delivers sealed container to WASA tube wells on demand**
- **Chlorine evaporates only in summer resulting drop of concentration by 0.25 mg/*l***
- **In winter, no evaporation of chlorine occurs**

WASA Chlorination practice

- **Chlorine concentration could be preserved by keeping the cap close tight**
- **Assessment of residual Chlorine is conducted by Chlorine Kit**
- **Residual chlorine is assessed on**
  - **a. Routine basis**
  - **b. Complaint basis**
  - **c. Upon Report of Unfit Water sample**
- **Residual Chlorine concentration vary from 0.1 – 0.5 mg/*l***

Water Safety Plan

Components of Water safety plan

- Health Based Targets
- System Assessment
- Operational Monitoring of Control Measures
- Management Plan
- Surveillance System

Implementation of Water Safety plan based on ISO 18001

Forming the Team → Refer to the Existing Water Supply System → Identify Hazard → Prioritize the Outcomes → Develop Water Safety Plan → Monitor the Control Measures

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Forming the Team

- Team must have operational experience
- Major role of team is to identify possible hazards linked with water quality in water distribution system and application of control measures

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Implementation of Water Safety plan based on ISO 18001

Ground Water Abstraction → Chlorination → Distribution System → Consumers

System Flow Diagram based on Groundwater Source

System Assessment

- ✓ Assessment of existing water supply system
- ✓ Developing system flow diagrams from source up to consumers

Hazard Identification & Control Measures

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibility
	Water Source			
1	Microbial and chemical Hazards	• Deterioration of water quality due to Natural Factors (seasonal variations, soil aggressiveness) and wastewater discharges	• Good practices of source protection through installation of filtration plant • Implementation of Industrial Effluent Standards and Volume Controls	SDO, Supervisor, Operator

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Hazard Identification & Control Measures

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibility
	Transmission Mains			
1	Microbial Hazard	• Poor water quality due to source contamination • Deposits of sediments • Disinfection failure due to high loads of organic contents in water from source	• Stop the flow of water by closing valves of problem area • Provide a temporary bypass or alternative supply line, if possible • Water sampling and its testing	SDO, Supervisor, Sub Engineer

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Hazard Identification & Control Measures

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibility
2	Structural Hazard	• Contamination due to poor jointing • Deterioration of pipe materials • Ingress of contaminated water from leaking valves	• Apply periodic Inspection of supply lines • Gradual replacement of old aged pipe infrastructure • Exercising of valves	SDO, Supervisor, Sub Engineer

Hazard Identification & Control Measures

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibility
	Reservoir			
1	Microbial hazard	• Poor water quality due to inadequate disinfection method • Shorter detention times	• Minimizing ingress of contamination to system and lengthening reservoir detention times • Fitting alarms triggered by low disinfectant level • Ensure inspection covers and ventilator covers remain in place	SDO, Supervisor, Sub Engineer

Hazard Identification & Control Measures

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibilit y
2	Structural failure hazard	• leakage through reservoir • leakage from partially open valves • taste in water due to internal corrosion of pipelines • deterioration of internal lining	• Regular reservoir inspections • Proper opening/closing of valves • Proper pipe material as per specifications should be used • Relining/painting of internal surface • Routine inspection to see any failure in piping and lining	SDO, Supervisor, Sub Engineer

Hazard Identification & Control Measures

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibility
Distribution Supply lines				
1	Microbial and Chemical Hazards	• Low chlorine residual in distribution system • Ingress of contamination due to pressure fluctuations • Reversed flows due to quick opening or closing of valves	• Maintain chlorine residual in the system as per requirement • Pressure Management • Apply flushing of pipelines	SDO, Supervisor, Sub Engineer

Hazard Identification & Control Measures

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibilit y
		• Contamination by backflow due to unauthorized connections • contamination during water main repair due to debris, soil or groundwater remaining in the main after repairs	• Disinfection prior to commissioning of water main • Follow design specifications for water supply system	SDO, Supervisor, Sub Engineer

Hazard Identification & Control Measures

Sr. No.	Hazard Type	Problems with associated hazard	Control Measures	Key Responsibility
		• Cross connection between water system and another system carrying non-potable water		
2	Structural failure hazard	• Ingress of contamination due to main burst • Ingress of contamination due to cracks in pipelines • Ingress of contamination due to improper closure of valves	• Maintenance of pipelines and valves • Use of approved pipeline types	SDO, Supervisor, Sub Engineer

Introduction to Ultra Filtration Systems

Filtration is applied to separate non-soluble substance from water by passing it through a porous medium. The goal is to make the water safe for drinking, free of any solids, bacteria, viruses or arsenic substance.

Importance of Filtration Systems.

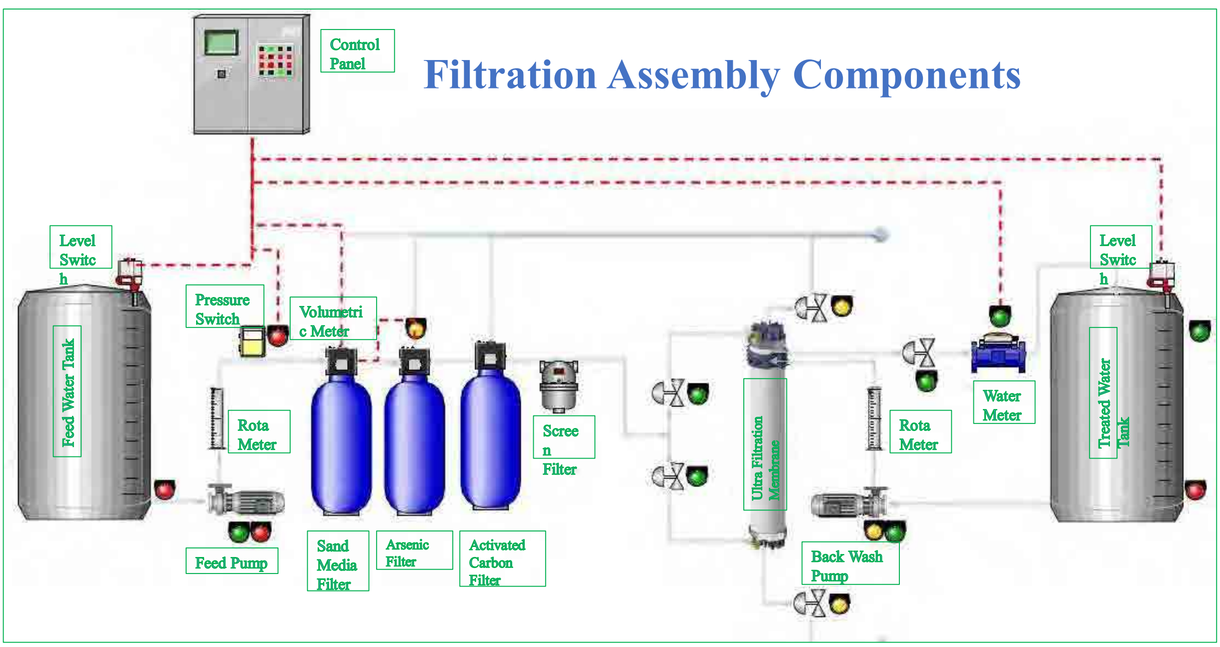
Importance of Filtration system at WASA tube well

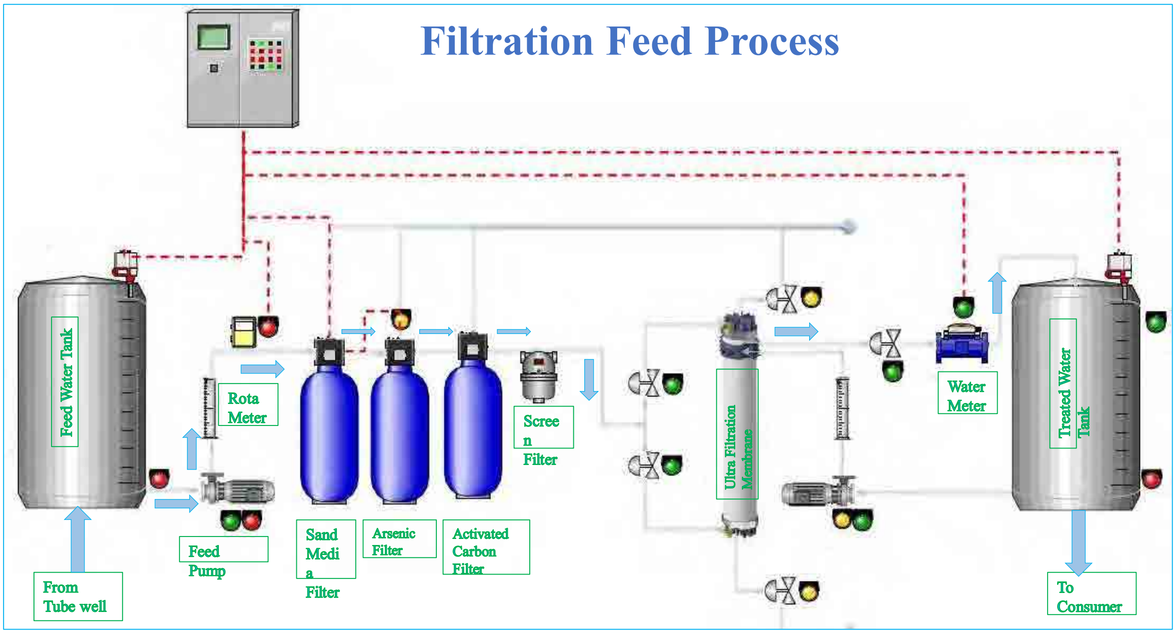
- In LDA – WASA Lahore Project the water filtration process is designed to remove pollutants which are Turbidity, Bacteria, Arsenic and heavy metals.
- Raw water will feed to Raw Water Storage Tank capacity 2,000 liter.
- Each plant has capacity of 4000 LPH.
- The water treatment process will start from raw water storage tank duly connected with the WASA tube-well or water supply line.

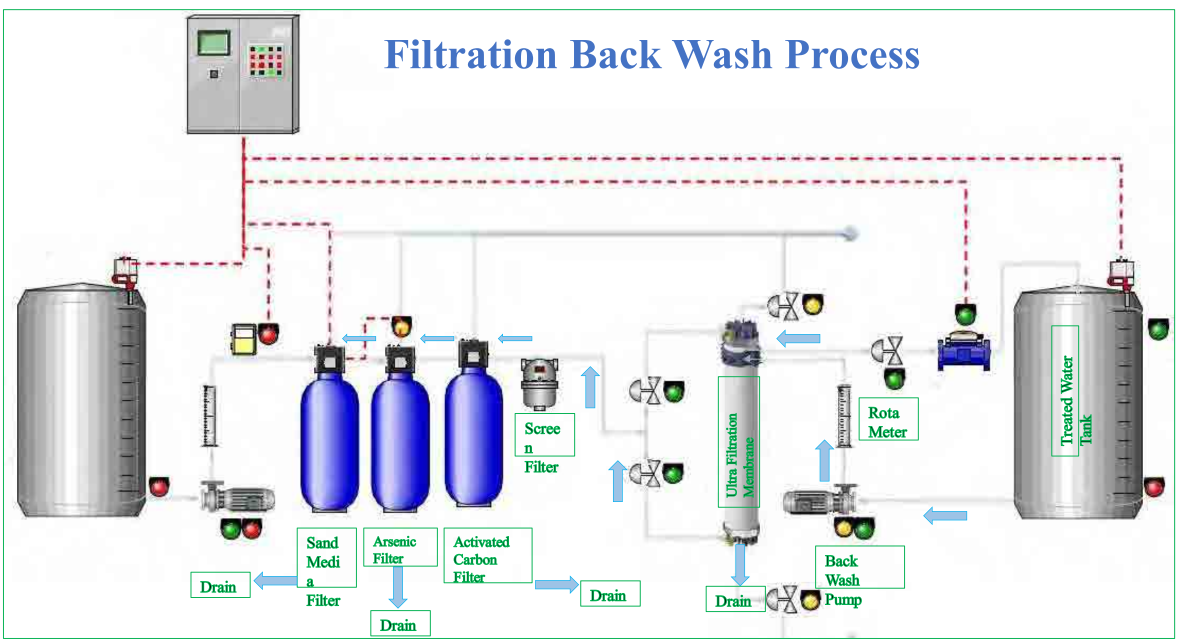
Main components of ultra filtration systems

- ✓ Raw water feed pump
- ✓ Raw water tank
- ✓ Feed and Backwash pumps
- ✓ Flow meters
- ✓ Pressure gauge
- ✓ Solenoid valves
- ✓ Sand filter
- ✓ Arsenic filter
- ✓ Carbon filter
- ✓ Y type strainer
- ✓ UF membrane
- ✓ Water meter
- ✓ Clean water tank
- ✓ Drain pipe

Filtration Assembly Components




Filtration Feed Process
Feed Water Tank
Rota Meter
Feed Pump
From Tube well
Sand Medi a Filter
Arsenic Filter
Activated Carbon Filter
Scree n Filter
Ultra Filtration Membrane
Water Meter
Treated Water Tank
To Consumer


Filtration Back Wash Process
Scree n Filter
Ultra Filtration Membrane
Rota Meter
Treated Water Tank
Drain
Sand Medi a Filter
Arsenic Filter
Activated Carbon Filter
Drain
Drain
Drain
Back Wash Pump

Operation of Filtration system

Pre Filtration Vessel

Function Flow Control Valve divided into 3 modes.

- ***Service Mode:*** Control water to flow as Downstream to filtrate. Water entrances Filtration Vessel at "Water Inlet" port and leaves at "Water Outlet" port.
- ***Back Wash Mode:*** Control water to flow as Upstream to back wash particles on the surface of filter media. Water entrances Filtration Tank at "Water Inlet" port and leaves at "Drain Outlet" port.
- ***Fast Rinse Mode:*** Control water to flow as Downstream to rinse. Water entrances Filtration Vessel at "Water Inlet" port and leaves.

Troubleshooting of Filtration System

ULTRA-FILTRATION Troubleshooting

TROUBLE	CAUSE	Solution
1. ULTRA-FILTRATION system does not work.	▪ Electrical control equipment is out of order. (Low Level Switch, High Level Switch and High Pressure Switch)	Check the electrical control system and replace damaged electrical control equipment.
	▪ A solenoid valve is damaged.	Check and change a coil of solenoid valve.
	▪ A ball valve is totally closed.	Check and open the ball valve. (BV2and BV3)
	▪ Any filtration tank, Screen Filter or ULTRA-FILTRATION membrane is clogged.	Check and Clean or Back wash it.
	▪ Feed Pump is out of order.	Check and repair or replace one if necessary.

Troubleshooting of Filtration System

ULTRA-FILTRATION Troubleshooting

TROUBLE	CAUSE	SHOOTING
2. Bacteria are present.	An ULTRA-FILTRATION membrane is damaged.	Check by the Integrity Test. Repair a broken fiber.
3. Flood flow rate decreases.	An ULTRA-FILTRATION membrane is clogged.	1. Back wash. 2. CEB is necessary.
	A filtration Tank or Screen Filter is clogged.	Back wash or Clean.
4. ULTRA-FILTRATION drainage water flows at all times.	A solenoid valve has a problem.	Check and clean up inside a solenoid valve or replace one if necessary.

O & M of Mechanical Equipment
WSD 5231

Heavy Machines

Module 3

Agenda

- ✓ Ice Breaker and Class Introduction
- ✓ Resources and handouts
- ✓ Equipment overview
- ✓ Assembly components

- ✓ Standard operating procedures
- ✓ Preventive maintenance
- ✓ Selection process

Icebreaker and Class Introduction

- Importance of heavy machinery in WASA operations
- What do we cover in this module?
- What to expect in this module?
- Goal and objectives of this module?

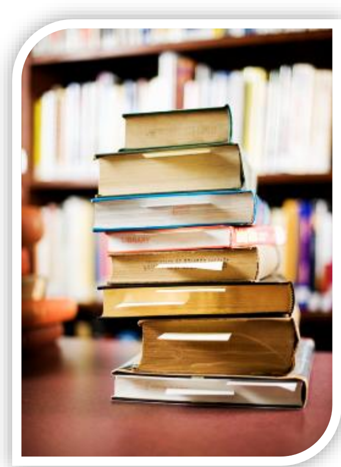
Now it is your turn…

- Degree and backgrounds?
- Share your work experience relative to heavy equipment?

- Any prior experience on heavy equipment?
- Why interested in this module?
- What best skills do you bring to the class?

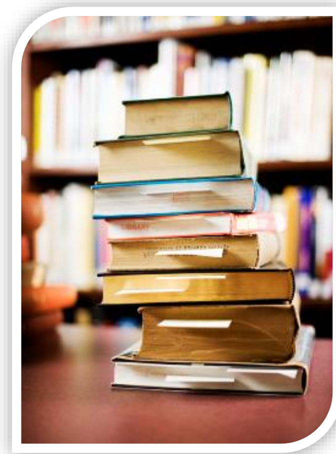
Resources and Handouts

- Owner's Manual, Hino Pak
- Kissan Engineering Operating Manuals (Suction and Jetting Unit)
- Participant lecture notes, Module 5
- Class presentations, Module 5

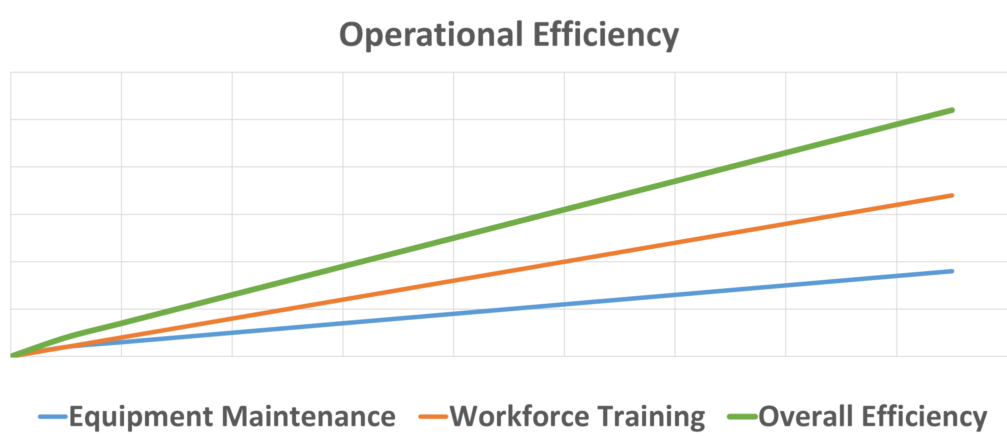


Resources and Handouts

- Heavy Equipment, Orlemann, Enthusiast Books, Madison, E. (2009)
- O and M Manual, Diesel Engines, Doosan, Doosan, Seoul
- JICA, Manual on sewerage and sewage treatment, Part B: Operation and Maintenance, Ministry of Urban Development, New Delhi



Importance of Equipment and Skills



Equipment Overview

Sr. No.	Name of Machinery	Total Machinery in Lahore, Towns						Total
		RT	ST	GBT	NT	IT	Drain	
1	Muck Sucker	12	6	11	8	10	3	50
2	Jetting Unit	11	6	12	8	9	3	49
3	Water Tankers	4	3	5	4	3	2	21
4	Tractor Trolley	4	6	6	4	5	9	34
5	Crane	3	3	1	2	1	-	10
6	Dump Trucks	1	-	1	-	-	69	71
7	Backhoe Tractors	1	-	-	-	-	29	30
8	Excavator	-	-	-	-	-	15	15
9	Trencher	-	-	-	-	-	2	2
10	Front-End Loader	-	-	-	-	-	5	5
11	Wheel Loader	-	-	-	-	-	2	2
12	Mazda Truck	1	1	1	1	-	-	4
13	Tractor	1	-	1	-	-	-	2
14	Dewatering set	-	-	343	-	-	-	343
15	Generators	38	41	67	19	29	4	198
16	Winch Machine	4	2	1	1	3	0	11
	TOTAL	**80**	**68**	**449**	**47**	**60**	**143**	**847**

Importance !!!

This could be in front of my home !

Equipment Overview

How would you like to do it?

Manually or with machines ?

Equipment Overview

Velocity Cleaners (Jetting Units)

- ✓ It is a high pressure, heavy duty three plunger pump mounted on a Nissan, Isuzu or Hino truck.
- ✓ Used to to remove the blockage of sewer lines and drains
- ✓ High pressure water jetting action loosens or breaks solid waste to remove blockage

Equipment Overview

Velocity Cleaners (Jetting Units)

Example Specifications:

✓**Dimension**	=	24.9 ft (L) x 8.2 ft (W) x 10.9 ft (H)
✓**Total Weight**	=	12,455 Kg
✓**Water Tank capacity**	=	4500 liters
✓**Pressure Range**	=	0 to 2843 PSI
✓**Jetting Hose Reel Length**	=	~ 60 M

Equipment Overview

Vacuum Cleaners (Suction Unit)

✓ Suction units create the vacuum required for siphoning of mud, slurry, grit and other materials from sanitary

✓ It is water sealing type vacuum pump vane having air cooling system capable of creating 90% vacuum mounted on a truck with PTO system or auxiliary engine (prime mover)

✓ Used to empty flooded sewerage lines and to clear blockage in combination with jetting unit

Equipment Overview

Vacuum Cleaners (Suction Unit)

<u>Example Specifications</u>:

- ✓ **Dimension** = 25.9 ft (L) x 8.2 ft (W) x 11.0 ft (H)
- ✓ **Total Weight** = 14,975 Kg
- ✓ **Water Tank capacity** = 4000 liters
- ✓ **Vacuum Pressure** = - 1 to -14 psi (~ - 0.97 bar)

Equipment Overview

Vacuum Cleaners (Suction Unit)

- ✓ **Suction Hose:** 100 mm diameter x 5 meter hose of heavy duty flexible PVC.
- ✓ **Flushing Hose:** 100 mm diameter hose for cleaning/ flushing of tank.
- ✓ **Water and sludge level indicator**: There are two types of sludge and water level indicators.
  - ✓Transparent water & sludge level indicator
  - ✓Alarm Type (not on all machines)

Equipment Overview

Gauges and Valves

- ✓ **Gauges**: Pressure and Vacuum gauges.
- ✓ **Safety Valves**:
  - ✓ auto safety valve for the vacuum pump to avoid over loading
  - ✓ auto safety valve for the pressure pump to avoid over loading



Equipment Overview

Gauges and Valves

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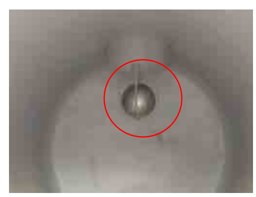


Equipment Overview

Backhoe

✓A backhoe loader is a versatile earth-moving equipment, multipurpose machine.

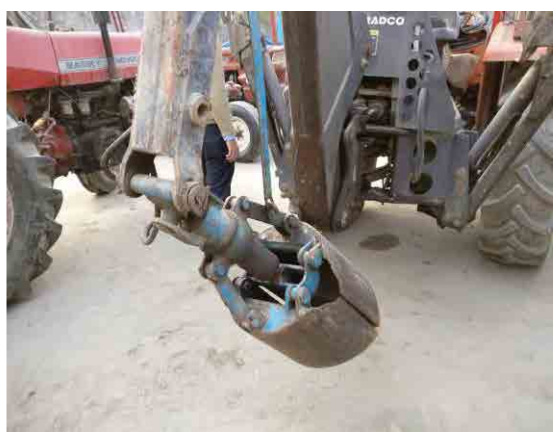
✓It can be used as an excavator and as a loader.

✓A backhoe attachment can be mounted or adjusted to allow digging along the walls.

Equipment Overview

WASA Backhoe

Koyker Backhoe with regular bucket



Bradco Backhoe with clamshell bucket (customised)

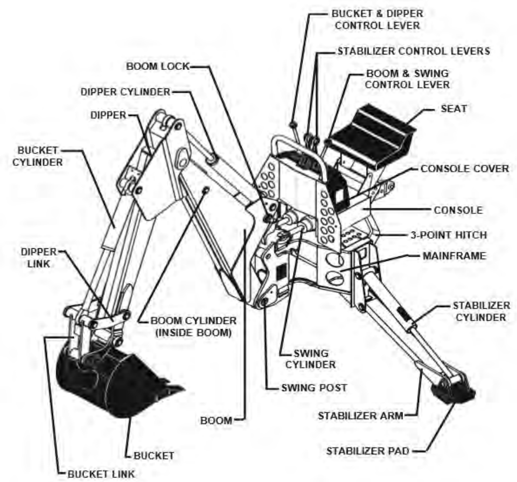
Equipment Overview

WASA Backhoe (Bradco, 3509)

✓**To be mounted ONLY on Category II tractors with 50 - 120 horsepower**

✓**2400 to 5000 lbs lift capacity**

✓**12000 lbs. GVW**



Equipment Overview

WASA Backhoe (Koyker, KB85)

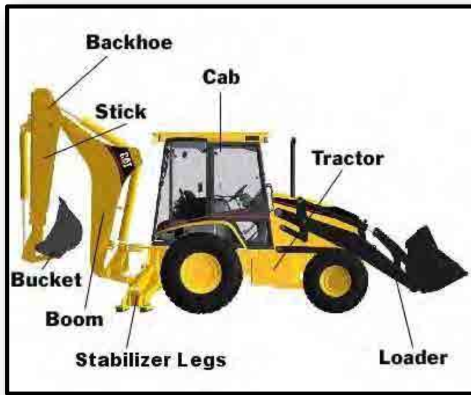
✓**To be mounted ONLY tractors with 30 - 60 horsepower**

✓**Lift at end of boom capacity 733 lbs.**

Equipment Overview

Backhoes have many uses:

- ✓ Digging trenches and holes
- ✓ Demolition work
- ✓ General grading and landscaping
- ✓ Heavy lifting such as the lifting and placement of pipe



Equipment Overview

Dump Trucks

- ✓ Dump trucks, as the name implies, are equipped with underbody hoists and are used to haul such as soil, sand, stone, gravel, dirt or hot asphalt in construction, road building and surface mining applications.
- ✓ Dump Trucks are available in various capacities depending upon the base vehicle.

Equipment Overview

Dump Trucks

- ✓ Available from 3 ton to 18 tons
- ✓ Control for Tipping & lowering located in driver's
- ✓ Single/double acting Imported Hydraulic Cylinder

Equipment Overview

Dump Trucks

- ✓ Available from 3 ton to 18 tons
- ✓ Control for Tipping & lowering located in driver's
- ✓ Single/double acting Imported Hydraulic Cylinder

Equipment Overview

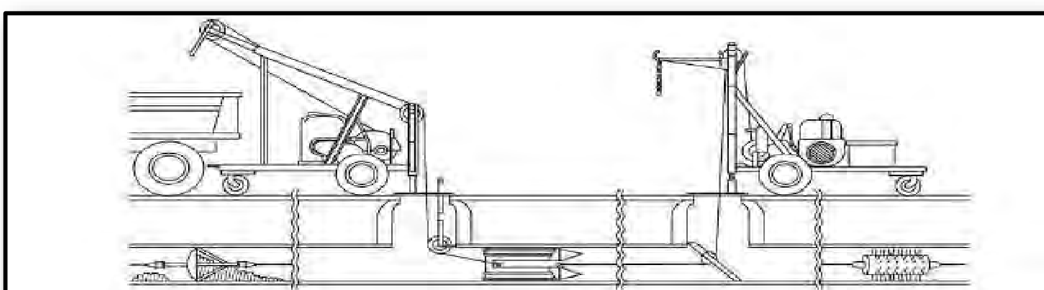
Water Tanker

- ✓ Water is routinely transported from regions where it is plentiful to regions where it is scarce. Several water conveyance and distribution techniques are available, and are actively used in many parts of Pakistan.
- ✓ Water Tankers (also known as water bowsers) can be a rapid means of transporting water to areas in need during the initial phase of an emergency. Water Tanker operations, however, are expensive and relatively time-consuming to administer.

Equipment Overview

Sewer Cleaning Bucket Machine

- ✓ It consists of two powered winches with cables in between for cleaning a section of sewer.
- ✓ It is also used along with other scraping instruments for loosening sludge banks of detritus or cutting roots and dislodging obstructions.



Source: EPA, 2003

Equipment Overview

General specification:

- ✓Length: 12'2"
- ✓Width: 5'11"
- ✓Height: 8'4"
- ✓Min HP: 25hp
- ✓Axle Configurations: Single
- ✓Max Bucket Capacity: 36"
- ✓Max Cable Length: 1500'

Equipment Overview

Dredger (Clam-shell)

- ✓ It consists of a grab bucket on a wire rope which is lowered into the manhole in the open condition with the help of a crane and pulley.
- ✓ The disadvantage in this system is that it cannot clean the corners of the catch pits of manholes.

Equipment Overview

The clamshell bucket is an attachment used with a crane for:

- ✓ vertical digging belowground level
- ✓ placing materials at considerable height, depth, or distance
- ✓ moving bulk materials from stockpiles to plant bins, loading hoppers, and conveyors
- ✓ to dig loose to medium compacted soil.

Main Assembly Component

Baseline Trucks

- ✓Diesel trucks such as ISUZU N-series, Hino and Mitsubishi are used to build jetting, suction, dumper and water tanker units.
- ✓These trucks offer good options, ease of serviceability and reliable operations if maintained properly

Table 1: Vehicle Specification

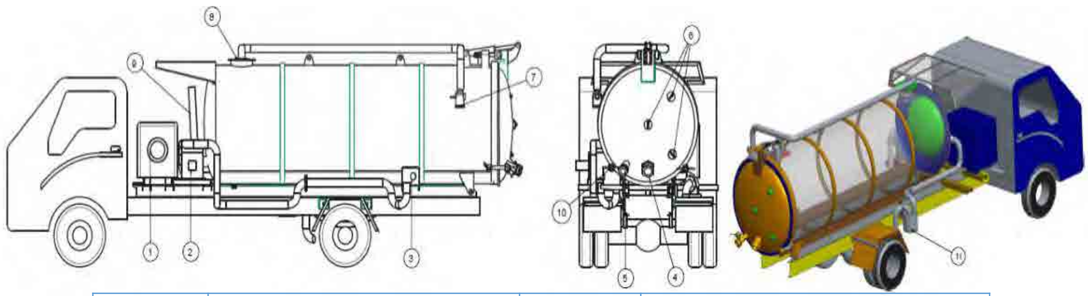
Vehicle Specification: Isuzu N-Series (courtesy RAVI Motors, Lahore)			
DIMENSION & WEIGHTS (Chassis only)		Short Wheel Base (SWB)	Long Wheel Base (LWB)
Wheel Base (WB)	mm	2460	3360
Overall Length (OAL)	mm	4610	5830
Overall Width (OW)	mm	1695	1695
Overall Height (OH)	mm	2120	2120
Tread Front (AW)	mm	1385	1385
Tread Rear (CW)	mm	1425	1425
Road Clearance	mm	190	190
Gross Vehicle Weight	Kg	5200	5200
Curb Weight	Kg	1670	1740
Pay Load	Kg	3530	3460
Fuel Tank	Litre	75	100

Vehicle Specification: Isuzu N-Series (courtesy RAVI Motors, Lahore)	
ENGINE	
Model	4JB1
Type	Diesel Engine, 4 Cylinder, OHV, Direct injection, water cooled
Displacement	2771 cc
Max Output (ps)(kw) / rpm	(80 ps) (59kw) / 3600 rpm
Torque (kgm)(N.m) / rpm	(17.8 Kgm) (175 N.m) / 2000 rpm
CLUTCH	
Type	Dry single Plate with diaphragm spring, Hydraulic Control
Size	240 mm
TRANSMISSION	
	Manual (5+1) with Synchronizers
AXLE	
Front Axle Type	Reverse Elliot, I-beam

Vehicle Specification: Isuzu N-Series (courtesy RAVI Motors, Lahore)			
Rear Axle Type	Banjo fully floating type		
SUSPENSION			
Front & Rear	Semi-elliptical alloy steel leaf spring, hydraulic double acting telescopic shock absorber.		
BRAKE			
Service Brakes Type	Hydraulic, dual circuit front two leading and Rear two leading.		
Parking Brakes Type	Mechanical expanded type at rear of transmission		
STEERING			
Type	Recirculating ball with integral power assisted.		
WHEEL & TYRE			
Type	7.00 x 16 – 14 PR		
No. of Tyres	7 including one spare tyre		
ELECTRICAL SYSTEM			
Battery	1 x 12V – 80 AH		
Generator	12V / 50A		

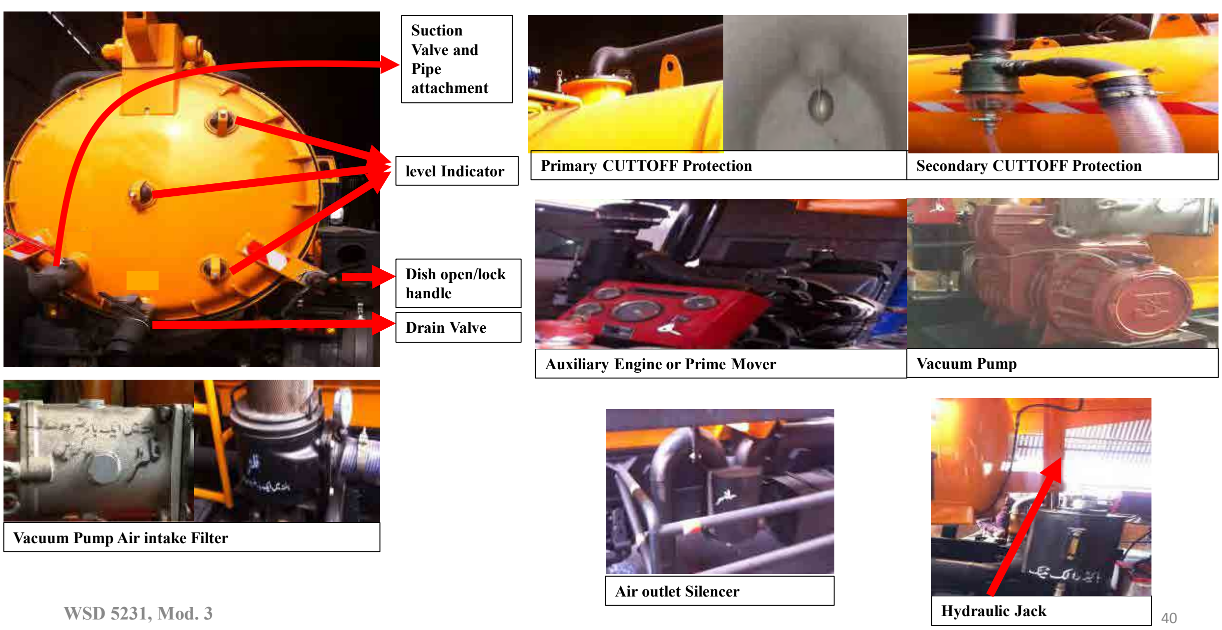
Videos for vehicle systems

Main Assembly Component, **Suction Unit**

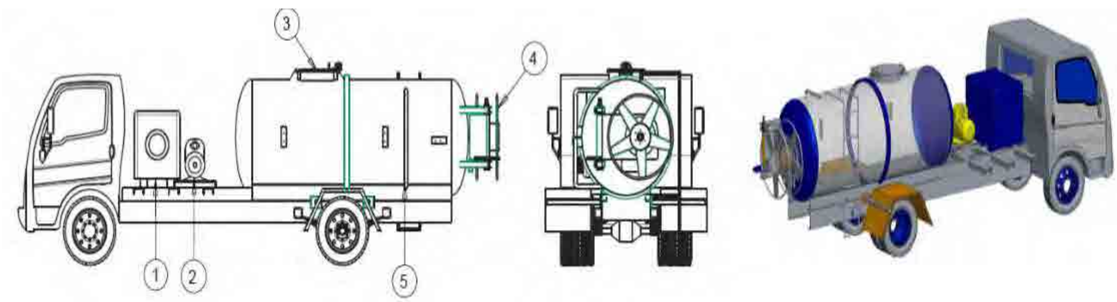


Parts No.	Description	Parts No.	Description
1	Auxiliary Engine	7	Secondary cutoff Protection
2	Vacuum Pump	8	Primary Cutoff Protection
3	Filter	9	Telescopic/Hydraulic Jack
4	Drain Valve	10	Dish Open/Lock Handle
5	Suction Valve	11	Silencer air exhaust from pump
6	Level Indicators	12	

Main Assembly Component, **Suction Unit**

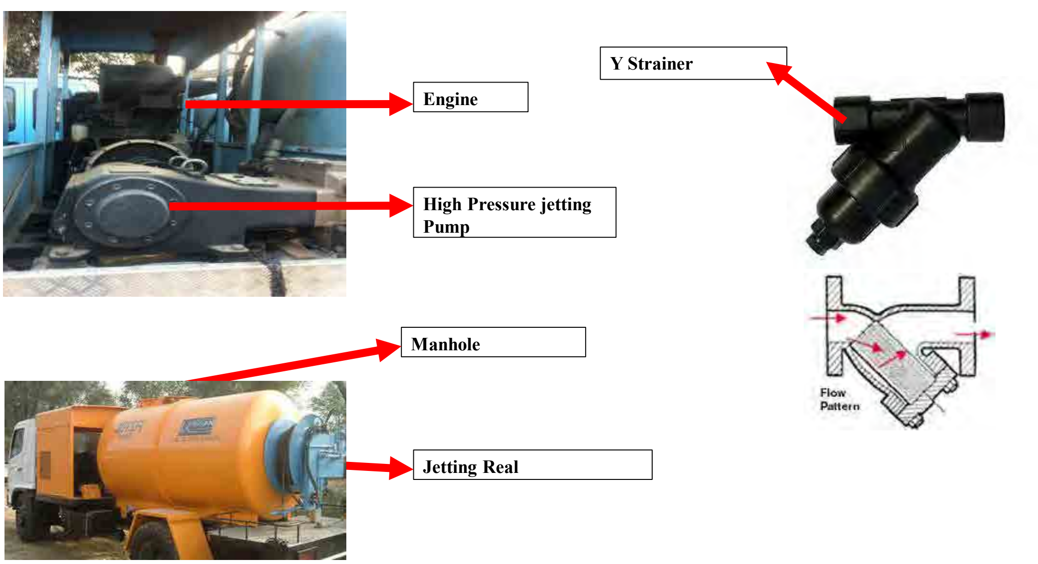


Main Assembly Component, **Jetting Unit**



Parts No.	Description	Parts No.	Description
1	Auxiliary Engine	4	Jetting Real
2	High Pressure jetting Pump	5	Water Level Gauge
3	Manhole for water refill	6	Y Strainer

Main Assembly Component, **Jetting Unit**



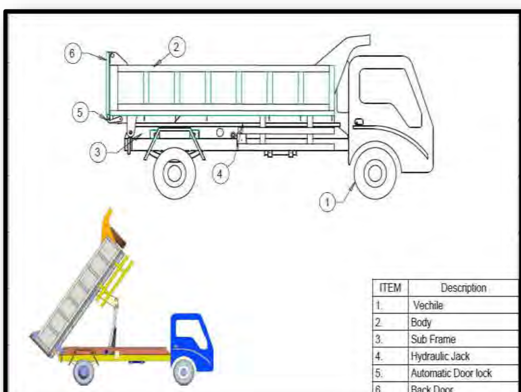
Main Assembly Component

Combined Jetting and Suction Unit

Combined Unit (suction off PTO, Jetting with axillary pump 150 to 200 bar)

Main Assembly Component

Dump Truck



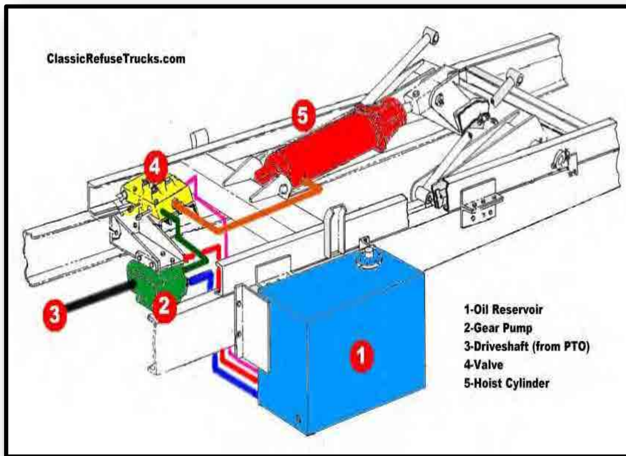
Dump Truck Components

Dump Truck (courtesy Kisaan Engineering)

Main Assembly Component

Load Capacity

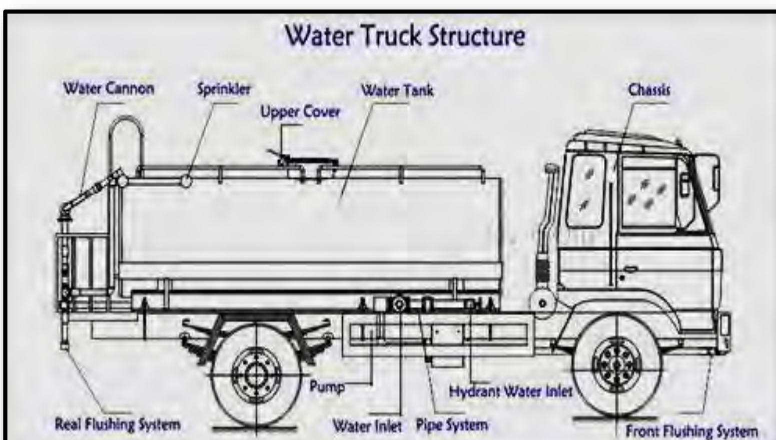
- ✓ 4 Ton or 3.3 cubic yards of dirt
- ✓ Average commercial dump truck holds anywhere from **10 to 14 cubic yards** of dirt.
- ✓ The Dump Trucks used at local service facilities are much smaller with a capacity of 5 to 10 cubic yards of dirt.



Dump Truck (courtesy Kisan Engineering)

Main Assembly Component

Water Trucks



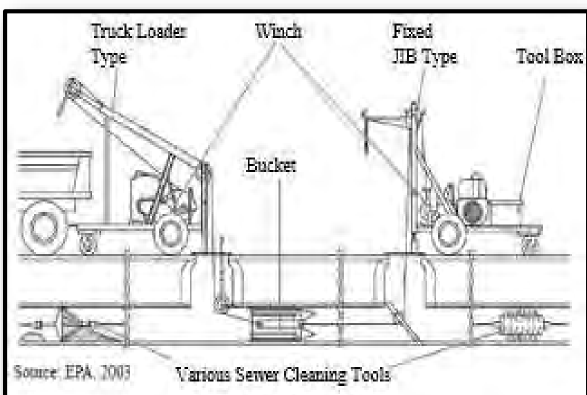
Water Tanker Components

Main Assembly Component

Water Tanker Centrifugal Pumps (PTO and stand-alone engine driven)

Main Assembly Component

Bucket Machine



Bucket Machine Components

Bucket Machines

Main Assembly Component

Solution to Problem	Type of Problem: Emergency Stoppages	Grease	Roots	Sand, Grit, Debris	Odors
Balling		●		●	●
High Velocity Cleaning	•	●		●	●
Flushing					●
Sewer Scooters		●		●	
Bucket Machines, Scrapers				●	
Power Rodders	●	•	●		
Hand Rods	●	•	●		
Chemicals		●	●		●

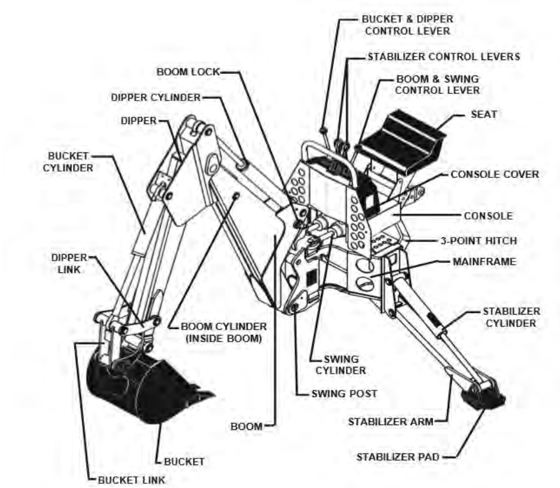
● = Most effective solution for a particular problem

• = Least effective solution for a particular problem

Bucket Machine effectiveness relative to sewer problems (source EPA)

Main Assembly Component

Backhoe



Main Assembly Component

Components of a Backhoe

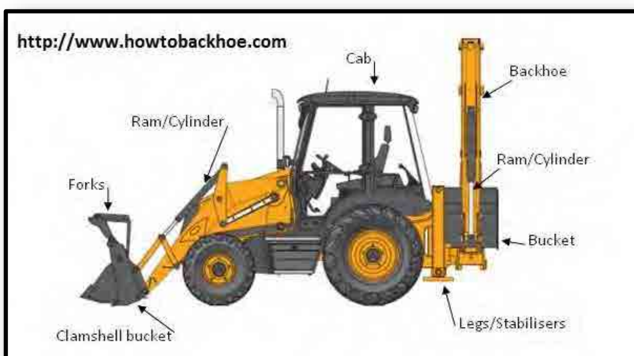
✓**Superstructure:**
  a. The main frame work of the equipment structure
  b. Also contains:
    i. Power source (i.e., engine compartment)
    ii. Main hydraulic pump and various hydraulic valves
    iii. Cab house operator's compartment and controls

✓**Undercarriage:**
    i. Axles front and rear
    ii. Drive train

Main Assembly Component

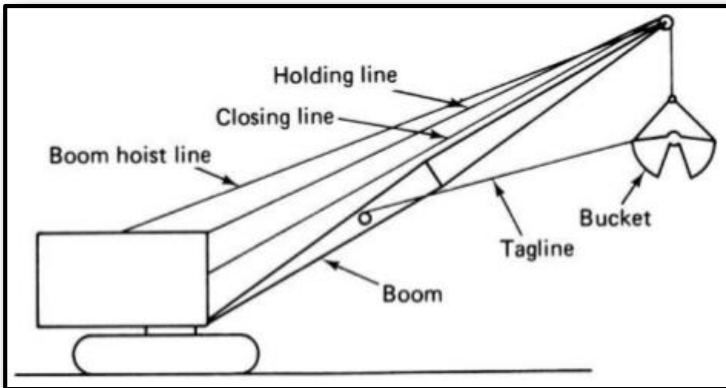
✓**Front end attachments**
  i. Bucket standard or four-in-one clam

✓**Rear attachments**
  i. Dipper wrist cylinder
  ii. Bucket or dipper
  iii. Lift or hoist hook
  iv. Compactor
  v. Pavement breaker
  vi. Outriggers



Main Assembly Component

Dredger (Clam-Shell)



Dredger (Clam-Shell) Components

Standard Operating Procedures

Jetting Unit

1. Climb and transport the truck to the work site.

2. Park the vehicle such that the hose reel is as close as possible to the work area.

3. Start the auxiliary Engine, unwind the pipe and insert almost 3 feet of hose pipe in the line to be cleaned.

Standard Operating Procedures

4. Increase the speed of the Engine until the pressure gauge shows a pressure of 150 bar or 2000PSI.
5. As the hose starts moving in the sewer line unwind the reel bit by bit.
6. After the work completion, wind the pipe on the hose reel again using the control valve.

Standard Operating Procedures

Preventive maintenance

Important Instructions before starting the Auxiliary Engine:

✓Check the engine oil of the auxiliary engine daily before starting the work if the level of engine oil is below the mark, add more engine up to the required level. Only engine oil type CR-40 should be used.

✓Check the condition of the pulleys and belts.

✓Check the fuel filter after every 6 months, in case of blockage change the filter.

✓Clean the air filter regularly depending on the usage of engine. If the engine is used with chocked filter it may be harmful to engine.

✓Use good grade of fuel for better performance of the engine and pump

Standard Operating Procedures

Important Instructions before starting the pump:

✓Check the pump for any types of abnormal sounds, any abnormal sounds produced by the pump is a matter of concern. In case of any abnormal sound, stop the pump immediately and check for the reason of the sound.

✓Check if the blades of the pump are worn out, replace if needed.

✓In this case contact the service department of the manufacturer.

✓Clean pump on weekly basis, this increases the efficiency and life of the pump.

✓The air intake can get clogged if dust particles get settled in it, so it needs to be cleaned at least once a week.

✓Check for proper oil level

✓Check for any leakages

Standard Operating Procedures

Suction Unit

1. Suction inlet fitted with quick coupling and revolving boom is provided for ease of operation. Take out the suction hose from carrier and couple it with the quick coupling.
2. Select appropriate suction inlet position according to location of sewer.
3. Starting Truck Engine & Engaging P.T.O

Standard Operating Procedures

4. Set PTO speed by rotating accelerator knob
5. The vacuum pump operating lever has three positions.

    V =Vacuum

    N=Neutral

    P=Pressure

    Turn lever to neutral position.

Caution: Check the level of disposable oil in the vacuum pump by means of dipstick.

Standard Operating Procedures

6. Tighten all clamps and start sludge suction operation.

Vacuum pump will start. At -0.6 bar open ball valve of inlet suction hose to commence suction of sludge.

Note:

a) Ensure Oil is dripping on the Bearing While the pump is operating.

b) Pump consumes oil and should never run dry.

Standard Operating Procedures

7. Keep observing the sight glass carefully. Stop the pump as the top most sight glass is half full.
8. Disengage PTO by Pushing vacuum pump lever in neutral position and place suction hose into the hose carrier.The vehicle can now be transported to dumping site.
9. Connect the hose (if required) with a 4” ball valve at the rear of tank for discharge.

Standard Operating Procedures

10. The tank will be emptied by 4" outlet valve. However, to remove sludge which may deposit inside the tank, the rear dish can be opened.

11. Vacuum pump consumes oil. Check oil before starting pump. Change vacuum pump oil after every two months.

Standard Operating Procedures

Dump Truck

✓**Prior to start and start-up**

1. Site hazards associated with dump truck operations are identified and safe operating techniques are used to minimize risk.
2. Engine power is managed to ensure efficiency of truck movements and to minimize damage to the engine and gears.
3. Engine power is coordinated with gear selection ensuring smooth transition and operation within torque range

Standard Operating Procedures

4. Dump truck is operated to work instructions under varied site and weather conditions in accordance with safe work practices and company operating procedures.
5. Road/traffic conditions are constantly monitored. Vehicle is brought to a halt without injury to personnel or damage to property, equipment etc using straight line braking techniques.

Standard Operating Procedures

✓**Load, transport and tip materials**

6. Vehicle is positioned at load and discharge points with a minimum of maneuver
7. Dump truck movements are smooth and well controlled.
8. Weight and distribution of load is assessed for type of material and size of vehicle to ensure it is within vehicle capacity.
9. Safety and security of load, including load cover requirements, are maintained from loading site to discharge site
10. Load is discharged on slope and/or over face at fill site.
11. Material is dumped/spread evenly.
12. Tray is cleared, lowered and secured before resuming travel.

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Standard Operating Procedures

✓**Park and Maintenance in accordance with organization's requirements**

13. Dump truck is safely parked, prepared for maintenance and shut down
14. Inspection and fault finding are conducted
15. Defective parts are removed and replaced safely and effectively
16. Regular programmed maintenance tasks are carried out

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Standard Operating Procedures

✓**Clean up**

17. Work area is cleared and materials disposed of or recycled in accordance with project environmental management plan
18. Vehicle, tools and equipment are cleaned, checked, maintained and stored in accordance with manufacturers' recommendations and standard work practice

Standard Operating Procedures

Water Tanker (Bowser, General Purpose)

1. Always perform pre-operational checks before putting a water truck in operation
2. Never operate a water truck without a thorough understanding of the rules at the construction site, as well as safe operating procedures of the truck
3. Make sure you allow sufficient time to warm the truck
4. Always wear your seat belt.

Standard Operating Procedures

5. Stay attentive - Watch for possible hazards (equipment and workers)
6. Adjust mirrors before your trip and use them often to monitor the activity around you
7. Confirm that regular maintenance is performed, making sure braking systems are maintained according to manufacturer specifications
8. Operate water trucks on safe haul roads (areas designed for vehicles)
9. Drive Smoothly .Make smooth turns and lane changes.
10. If you must make a quick stop, use controlled or stab braking.
11. If you lose brake pressure during, pull the emergency brake and use the manual transmission to stop the truck.

Standard Operating Procedures

Inspecting Tanks:

12. On all tank vehicles, the most important item to check for is leaks. Check under and around the vehicle for signs of any leaking. Don't carry liquids or gases in a leaking tank. **In general, check the following:**
13. The tank's body or shell for dents or leaks.
14. The intake, discharge, and cutoff valves - Make sure the valves are in the closed position except when loading or unloading.
15. The pipes, connections, and hoses for leaks, especially around joints.
16. The manhole covers and vents.

Standard Operating Procedures

Liquid Surge:

17. Liquid surge results from movement of the liquid in partially filled tanks. For example, when coming to a stop, the liquid will surge back and forth. When the wave hits the end of the tank, it tends to push the truck in the direction the wave is moving.

18. If the truck is on a slippery surface, the wave can shove a stopped struck into an intersection. Remember: A half-full tank is more dangerous than a full tank!

Standard Operating Procedures

Baffled Tanks:

19. Baffles allow the liquid flow through and helps control the forward and backward liquid surge. However, side to side surge can still occur which can cause a rollover. Drive slowly and be careful in taking curves or making sharp turns with a partially or fully loaded tanker.

Non-baffled Tanks:

20. Smooth bore tankers have nothing inside to slow down the flow of liquid. Therefore, forward and back surge is very strong. Be extremely cautious (slow and careful) when driving smooth bore tanks, especially when starting and stopping.

Standard Operating Procedures

Special add on guidelines for Water Tankers on drinking clean water supply:

1. All water supplied in bulk form must originate from a regulated drinking water system, registered with the government according to Drinking-Water Systems Regulation.
2. At the time of filling, all water sources are currently potable (i.e., not under a boil water/drinking water advisory) and meet the WHO requirements**.**
3. The water tank and any equipment used to supply water shall not have been previously used to transport a noxious, hazardous, or toxic substance or liquid.
4. The interior surface of water tanks shall be constructed with a food-grade material that is non-corrosive (i.e., stainless steel, fiberglass, plastic) and shall not be used for any other purposes.

Standard Operating Procedures

5. With the exception of cleaning, emptying or filling of the tank, the inlet or opening must be covered and sealed at all times.
6. Hoses and nozzles must be covered when not is use and disinfected before <u>each</u> use to avoid disinfection.
7. Food-grade lubricants shall be used if the pumps are used for the transmission of drinking water to or from the water haulage vehicle.
8. Ensure the water tank and any removable equipment (i.e., hoses) are permanently labeled with the words “Drinking Water” or “Potable Water” in letters at least 15cm (6”) high on the water tank.
9. The water tank shall be cleaned and disinfected in accordance with the Guidelines for Disinfecting a Water Haulage Tank Water Quality Standards.
10. Appropriate measures must be taken to protect the water from contamination.

Standard Operating Procedures

Guidelines for Disinfection a Water Haulage Tank

11. Disinfection of the water tank must be conducted on a monthly basis. **The following procedure requires the use of unscented household bleach (5.25% sodium hypochlorite)**
12. Shut off valve to water tank distribution lines. Drain all water from the bulk tank.
13. Wash and remove dirt from the inside surfaces of the tank by using a high pressure hose.
14. Remove wash water and sediments from bottom of tank. These can be vacuumed out.
15. Rinse inside surfaces of tank with clean potable water. Remove wash water.

Standard Operating Procedures

16. Disinfect the inside surfaces of the tank and distribution lines as follows:
17. Use 1 litre of household bleach for every 1000 litres of water. This provides 50 milligrams per litre chlorine solution. For example: a 3,500 gallon truck will have about 16,000 litres of water.
18. Add bleach while refilling the vehicle with water from the drinking water system. This will ensure thorough mixing of the bleach solution.
19. Ensure the tank is completely filled to allow interior surfaces to come in contact with the bleach solution.
20. Open valve to water tank distribution lines.

Standard Operating Procedures

21. Run water out of water taps in the distribution lines until the smell of bleach is detected.
22. Shut off water faucets and valves to distribution lines. Ensure the tank is kept completely filled to allow a contact time of at least 12 hours
23. After 12 hours, drain all the water from the bulk tank into a municipal sanitary sewer or, if not available, a storm sewer. The tank can now be filled with fresh potable water.
24. Flush water tank by opening valves of distribution lines and running water until no smell of bleach is detected.

Standard Operating Procedures

25. D. Disinfection of hose-end prior to each use
26. Hose end connections must be disinfected before each use.
27. A bleach solution for dipping hose ends can be made with unscented household bleach (5.25% sodium hypochlorite) as follows:
28. 100 ml. of bleach per 10 liters of water or
29. 1/2 cup of bleach per 3 gallons of water.

Standard Operating Procedures

Bucket Machines

Bucket machines are very useful in cleaning medium to large size sewers.

The following steps are usually followed:

1: Make a Way

Before starting cleaning, connection between the two manholes has to be established. Jetting or rodding should be done to establish this connection.

Standard Operating Procedures

2.Preparation

- ✓A light steel wire or rope 5 mm in diameter is drawn through the sewer section.
- ✓“Live winch” is positioned over the manhole on the downstream side of the sewer.
- ✓The “dead winch” over the manhole on the upstream side.
- ✓Wire or rope from the dead winch is tied to the smaller end of the bucket.
- ✓Wire rope from the live winch is tied to the bigger end of the bucket
- ✓Shake block, Snatch block, jacking screw and a manhole tube is used to support the wire or rope in the sewer.

Standard Operating Procedures

3: Operation

- ✓The bucket is pulled through the sewer by the dead end winch.
- ✓The bucket flap pivots to allow free passage of the silt through the bucket.
- ✓Normally bucket should not travel more than 5 to 10 meters at a time.
- ✓As the pull is reversed by the live winch, the bucket flap closes and full load of debris will be brought to the surface.
- ✓The cycle is repeated, progressively drawing further through the sewer. Care should be taken not to damage the fabric of the sewer.

Standard Operating Procedures

Backhoe

1. Set up the proper work zone control for the area where the work will be performed utilizing the Ohio Manual on Uniform Traffic Control Devices (OMUTCD)
2. Make sure the worksite footing has enough strength to support a backhoe firmly in order to prevent cave-ins
3. Watch for clearance height
   - Know what is above you at all times.

Standard Operating Procedures

4. Know your weight limitations for lifting capacity
5. Check underground utilities
6. Beware of power lines
   - Stay a minimum of 10 feet from power lines
7. Make sure that lights and warning signs are visible to everyone in the work area

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Standard Operating Procedures

Equipment Start-Up

8. The operator must be seated with the seat belt fastened to operate the controls.
9. Start the engine with the throttle control lever set at idle.
10. When the key switch is turned on, the buzzer will sound briefly.

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Standard Operating Procedures

11.Buzzer Stop Alarm (if so equipped)

a. The engine buzzer will sound whenever the engine oil pressure is low, the coolant overheats or the hydraulic oil overheats

b. The alarm's location will vary depending on manufacturer

c. The buzzer for low engine oil pressure will not stop until the equipment is turned off

d. For high coolant temperature and high hydraulic oil temperature, reduce

Load immediately and run the engine at reduced engine speed

Standard Operating Procedures

12.Engine coolant temperature gauge

a. The needle will point to the white zone until the engine is warm

- Normal operating temperature is in the green zone

b. Do not stop the engine when the needle enters the red zone or the temperature will farther

c. Instead of stopping the equipment, stop digging immediately and place the equipment at the lower revolutions per minute (RPM) speed recommended by the manufacturer until the temperature drops

- If the problem continues, inspect for a plugged radiator or coolant leakage

Standard Operating Procedures

13.Alternator voltage indicator

a. The indicator will light when there is low voltage output from the alternator

b. Check the battery's charge and the electrical system

14.Engine oil pressure indicator

a. If the engine oil pressure light (red indicator) comes on and the buzzer sounds while operating, stop the engine immediately

- Cold oil, a low level of oil or operating the equipment at an extreme angle may cause the indicator to light

Standard Operating Procedures

15.Air filter restriction indicator (if so equipped)

a. The indicator will light when the air filter elements are plugged

b. Stop operation of the equipment and clean or replace the elements

16.Hydraulic oil temperature indicator

a. The indicator will light when hydraulic oil overheats

b. The red indicator will light and the buzzer will sound if continue operation will cause damage to the hydraulic components

c. Stop the engine immediately and consult with a mechanic to correct the problem before starting the equipment again

Standard Operating Procedures

17.Hydraulic oil filter restriction indicator (if so equipped)

a. The indicator will light when the hydraulic oil filters are plugged

b. Immediately stop operation and have a mechanic replace the filters

18.Light indicator

• The indicator comes on when work lights (i.e., headlights, boom lights, etc.) are active

Standard Operating Procedures

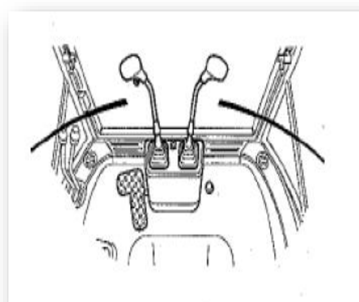
19.Levers

a. Located on either side of the operator's seat

b. Used to control the boom, dipper and bucket

c. Horn button location depends on manufacturer

d. The back-up alarm will sound when the FNR lever is placed in the R position



Standard Operating Procedures

20. Pedals

a. Accelerator and brake pedals are used by the operator to move the machine forward and reverse along with the FNR lever.

b. The dipper extension pedal if a backhoe is equipped with an extension rod.

21. Operating lights (if equipped)

a. Turn on all light switches for driving and to light up the instrument panel

b. Turn on night time operating lights if so equipped

Standard Operating Procedures

22. Warm weather warm-up for the engine

a. Clear the area of all persons before running the machine through the warm-up procedure

b. After the engine starts, run at 1/3 speed for 30 seconds

- 1/3 speed can be achieved by raising the throttle lever to approximately 1/3 of traveling distance from the start position to full throttle

c. Do not run the engine at fast or slow idle and do not accelerate rapidly during the warm up

d. Operate a backhoe at less-than-normal loads and speeds until the engine is at normal operating temperature

Standard Operating Procedures

23. Cold weather warm-up (below 32 degrees Fahrenheit)

a. Clear the area of all persons before running the machine through the warm-up procedure

b. Start the engine and run at half speed for 5 minutes

c. Do not run at fast or slow idle and do not accelerate rapidly during the warm up

d. Confirm that no one has entered the operating area

e. Operate boom, arm and bucket functions by moving cylinders a short distance in each direction for the first time

f. Continue cycling cylinders by increasing the traveling distance during each cycle until a full stroke is reached

Standard Operating Procedures

g. If hydraulic functions still move slowly, repeat the two steps immediately above

h. Safety precautions specific to a cold weather warm-up

i. If hydraulic oil is cold, the hydraulic functions will move slowly

ii. Do not attempt normal backhoe operation until the hydraulic functions move at close to-normal cycle times.

iii. In cold conditions, an extended warm-up period will be necessary

iv. For faster warm-up, cover the radiator and oil cooler during the warming period

Standard Operating Procedures

v. The hydraulic filter restriction indicator may flicker during warm up

vi. Operate functions slowly until the engine and hydraulic oil are thoroughly warmed

vii. Avoid sudden operations of all functions until the engine and until the engine and hydraulic oil are thoroughly warmed up.

24. Moving a Backhoe

a. Prior to traveling over long distances, be sure to lock boom in place and ensure the slow moving vehicle sign is on the back of the backhoe and visible to the public

b. Insert swing lock pin

c. Select gear for travel speed and place FNR lever in the F position

Standard Operating Procedures

d. If traveling a long distance put the transmission in 3rd or 4th gear (depending on the distance which will be traveled) then put the FNR lever in the F position

e. If roading, LOCK brake pedals together; this ensures even braking power to each wheel.

f. Always drive the backhoe carefully.

g. During freezing weather, park the machine on a hard surface to prevent freezing to the ground.

i. Clean debris from tires and frame daily.

ii. If tires are frozen to the ground, raise the tires one at a time using the boom and move the machine carefully to prevent damage to the drive train and tires.

Standard Operating Procedures

h. Do not drive a backhoe with the arm cylinder fully extended

- Retract the arm cylinder slightly to prevent cylinder damage

i. Throttle control lever

ii. Use the engine speed control lever to set engine speed at desired RPMs

iii. To be used when digging only

Standard Operating Procedures

25. Stopping the engine

a. The turbocharger may be damaged if the engine is not properly shut down

b. Before leaving the operator's seat, perform the following steps

i. Park the machine on a level surface

ii. Set parking brake

iii. Lower the front bucket to the ground

iv. Lower the boom and dipper to the ground

v. Lower the outriggers

vi. Run the engine at half speed without load for 2 minutes

Standard Operating Procedures

vii. Push the speed control lever to the idle position
viii. Turn the key off
ix. Remove the key from the switch

26. Operating a Backhoe Digging Mechanism

a. Pilot control shut-off lever (if equipped)

b. This lever is the shut-off point for all hydraulic controls

i. Locking the switch in place will render a backhoe's lever inoperable

ii. Pull shut-off lever back to lock position to shut off hydraulic pressure to both right and left control levers and foot pedals

Standard Operating Procedures

27. Control levers

a. These levers are utilized to operate the boom, dipper, and bucket

b. When the lever is released, it will return to neutral

c. Read the operator's manual for directions on how the equipment controls are designed to work

i. Cleaning

ii. Keep the operator's cab clean

Standard Operating Procedures

28. Operating in water or mud

Be careful not to operate the machine in water or mud above the swing pin. Causing the swing pin to be submerged will cause excessive wear.

Standard Operating Procedures

29. Starting an excavation

a. Prior to starting the excavation, ensure the proper bucket has been selected for the job to be completed.

b. Place the machine on level ground and use the stabilizers before digging

- This creates a level-bearing stable surface for the tracks.

c. Position the arm slightly forward of the perpendicular position.

Standard Operating Procedures

d. Place the bucket teeth on the ground with the bottom of the bucket at approximately a 45 degree angle to the ground

e. Pull the bucket toward a backhoe using the dipper arm, boom and bucket functions until the bucket is full of material

- Continue this procedure until the desired depth is reached

30. **Straight line trenching**

a. The process by which a straight line dig is dug:

i. Drive two stakes in at the beginning of the excavation process.

ii. Drive the first stake in immediately behind the starting point and the second stake approximately 30 feet behind the first.

Standard Operating Procedures

iii. Positioning these stakes in a line extending from the centerline of the operator's position enables you to use them as a sight gauge

iv. This technique is especially useful where frequent repositioning of a backhoe is needed

31. Moving a backhoe off an embankment

a. To move a backhoe off an embankment, position the bucket with the flat surface resting on the ground

- The angle of the boom should be perpendicular to the operator

Standard Operating Procedures

b. The bucket must always be placed on the ground before beginning to move off the embankment; never move the machine and the bucket simultaneously off the embankment

- If the machine and the bucket are moved simultaneously off the embankment, there is a great risk of the bucket absorbing the force of the fall, damaging the equipment

c. The bucket must be on the ground before the machine begins to tip

d. As the unit moves forward, raise the boom and retract the arm until the tires reach the lower ground level

Standard Operating Procedures

e. Raise the bucket off the ground

f. Position the front bucket on the upper ground with the flat surface of the bucket resting on the ground

- Keep the stabilizers up about 1 foot

g. Place the FNR lever in R and slowly backup keeping pressure on the front bucket

h. When the tires clear the embankment, raise the front bucket to lower the tires onto the lower ground level

i. To move a backhoe onto an embankment, reverse the procedure

Standard Operating Procedures

32. Craning/overhead lifting

a. The process of using a sling attached to the bucket to move a heavy item (such as a catch basin) from one point to another.

i. Secure sling/chain tightly to the load being lifted, always using grade 80 chain

a) Many buckets are equipped with a bucket loop through which the chain for the sling can be secured

b) If your equipment has a bucket loop, use when securing the sling/chain

ii. Coordinate hand signals with your designated ground guide before starting

iii. Know the location of all persons in the working area

iv. Attach a hand line to the load and make sure the person holding it is away from the load

Standard Operating Procedures

v. Before starting the job, test your load by doing the following:

a) Park the machine close to the load

b) Attach the load to the machine

c) Raise the load 2 inches above the ground

d) Swing the load all the way to one side

e) While keeping the load close to the ground, move it away from the machine

f) If there is any indication of reduced machine stability(i.e., tipping starts to occur), lower the load to the ground to reposition boom and dipper

vi. Lift the load only as high as necessary when moving

Standard Operating Procedures

b. Safety precautions

i. Never move the load suddenly

ii. Never move a load over a person's head

iii. Do not allow anyone near a load

iv. Keep everyone away from a raised load until blocks are supporting it or the load is set on the ground

v. Fill the front bucket for more counterbalance and stability

vi. Never attach a sling/chain to bucket teeth

vii. Keep load as close to the machines as possible

Standard Operating Procedures

33. Operating on a slope

a. Level off a work area

b. Avoid swinging the bucket farther than necessary in a downhill direction

c. Do not lift the boom too high on the uphill side. A backhoe may tip backwards if the slope is too steep

d. If at all possible, keep your spoil pile (dirt which is being dug out) on the uphill side of your excavation to make it easier to back fill and ensure the pile is a minimum of two feet from the excavation.

Standard Operating Procedures

34. Hydraulic pavement breaker (manufacturer specific)

a. An additional attachment available for the equipment which can be used in lieu of the bucket

b. The pavement breaker functions by using a jack-hammer type effect on the object to be broken apart

c. Refer to the operator's manual for specific instructions on how to use the attachment

d. General operating tips

- i. Perform the required checks and inspection daily before operation
- ii. Avoid entry of contamination into the hydraulic system when switching the breaker with the bucket

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Standard Operating Procedures

- iv. Do not operate the breaker with hydraulic cylinder rods fully extended or fully retracted to prevent cylinder or machine damage
- v. Do not operate the breaker in one position for over 1 minute
- vi. Do not use the breaker as a lever or a ripper (extending the hammer fully in front of the operator and pulling the hammer toward the operator while hammering) to prevent damage to the chisel or its holder
- vii. Do not use the breaker to move rocks
- viii. Do not operate the breaker in water
- ix. Operate the hydraulic pavement breaker carefully to avoid hitting it against the object to be broken

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Standard Operating Procedures

x. Upon completion of breaker operation, release the pressure from the lines by depressing the breaker control pedal/switch

xi. Failure to release the pressure will shorten the life of the breaker

35. Back blading utilizing the front bucket

a. Place front bucket flat on the ground

b. Tilt bucket slightly forward

c. Backup length of area which needs to be leveled

d. Just prior to the end, tilt bucket back up to feather out material being leveled

Standard Operating Procedures

36. Operating tips

a. Make sure you know the location and function of each control before operating

b. Whenever possible, position the machine on a level surface

c. Do not hit the stabilizers with the bucket when digging

d. Do not use the bucket as a hammer or pile driver

Do not try to shift rocks and break walls using a swinging motion

e. To avoid damaging the cylinders, do not strike the ground with the bucket or use the bucket for tamping (flattening a surface) when the bucket cylinder is fully extended (bucket completely curled under)

Standard Operating Procedures

f. Adjust the length and depth of each cut to produce a full bucket at every pass

g. A full load should be the first objective, followed by speed, in order to increase productivity

h. Do not try to break ledge rock by dropping the front of the bucket on the bucket teeth for penetration—serious damage could result

i. Once a trench is open, ledge rock can be broken by pulling the bucket up under the layers

- The top layers are pulled out first, with one or two layers being lifted at a time

j. Never place any part of your body beyond the window frame

k. When digging, avoid contacting stabilizers with the boom cylinders or the bucket

Standard Operating Procedures

37. Parking a backhoe

a. Before leaving the operator's seat, perform the following steps

i. Park the machine on a level surface

ii. Lower all attachments to the ground

iii. Follow procedure previously mentioned for shutting down the engine

38. Lock all compartments

a. A backhoe is equipped with locks on the cab door and side shields

b. Use these locks to safeguard the machine

c. It is the operator's responsibility to lock the equipment to protect it from vandalism

d. Shut off master switch, if so equipped. The switch will usually be found in one of the compartments.

Standard Operating Procedures

Dredger (Clam-shell)

Clamshell operating procedures are as follows:

1. Position and level the crane, ensuring the digging operation is as close to the radius as the dumping operation. This prevents you from having to boom up and down, resulting in a loss of production.
2. Select the correct size and type of bucket for the crane.
3. When lowering the clamshell bucket, if too much pressure is applied to the closing line brake, the bucket will close and an excess amount of wire rope will unwind from the holding line hoist drum. To avoid this, you should release the holding line and closing line brakes simultaneously when lowering the open clamshell into the material for the initial bite.

Standard Operating Procedures

4. If, during hoisting, the hoist line gets ahead of the closing line, the bucket will open and spill the material. The operator must hoist both the closing and holding lines at the same speed to keep the bucket from opening and spilling material.
5. When the clamshell bucket is raised enough to clear all obstacles, start the swing by engaging the swing control lever. Hoisting the bucket can be performed, as it is swung to the dumping site. The spring-loaded tag line will retard the twisting motion of the bucket if the swing is performed smoothly.
6. Dumping and unloading the clamshell is performed by keeping the holding line brake applied while the closing line brake is released. Apply the closing line brake quickly after the load is dumped to prevent the closing line from unwinding more wire rope than is needed to dump the material. After the bucket is emptied, swing the open clamshell back to the digging site. Then lower the open bucket and repeat the cycle.

Standard Operating Procedures

The clamshell operating cycle has four steps:

- filling (closing) the bucket
- raising the loaded bucket
- swinging
- Dumping

The boom angle for clamshell operations should be between 40 to 60 degrees. Be careful when working with higher boom angles, as the bucket could hit the boom

Preventive maintenance of heavy machines

Why Preventive Maintenance is so important?

There are two types of maintenance strategies employed by companies that rely on equipment

1. Reactive maintenance
2. Preventive maintenance

Here is a look at 7 reasons why preventive maintenance is a much better alternative to reactive maintenance.

1. Cost Savings
2. Improved Safety
3. Increased Equipment Efficiency
4. Decreased Equipment Downtime
5. Improved Reliability
6. Conservation of Assets

Record keeping

✓A complete record of operation of each equipment should be present.

✓This will help with the future planning of:

- ✓ equipment work hours
- ✓ efficient and reliable operations
- ✓ and for checking the efficiency of the and its drivers

Log book

The log book should record:

- ✓Date
- ✓Operator's name
- ✓Pre-task equipment inspection notes
- ✓Task start and finish time
- ✓Location, time and mileage
- ✓Quantity of material used (if applicable)

Log book

The log book should record:

- ✓Rest periods (mandatory)
- ✓Fuel quantity, time and date added (with mileage)
- ✓Maintenance dates with part replacement records
- ✓Signature of tasks completed
- ✓Signature of any extra approvals for major repairs
- ✓After-task equipment inspection notes

Regular Checkups

- ✓The service intervals of the equipment minimize overall operating costs and require less downtime for service and repairs.

- ✓It is important to keep an eye on equipment's status between services and help keep it in excellent condition by solving problems.

At each full stop

- ✓ Two important operating components of an equipment are:
  - ✓ engine and tires
  - ✓ tracks and crawlers

- ✓Its necessary to check that :
  - ✓ they operate reliably, efficiently and safely.
  - ✓ it's a good idea to check engine oil and wear levels of tires, tracks and crawlers at every fuel stop, or once per week.

Once a Month

- ✓Its important to Maintain other fluids at their proper levels.
- ✓ Consult the owner's manual for guidelines related to:
  - ✓ transmission or gearbox fluid
  - ✓ engine coolant
  - ✓ power steering fluid
  - ✓ windshield washer fluid
  - ✓ hydraulic fluid
  - ✓ clutch or brake fluid
  - ✓ Check all exterior lights and warning siren functions for operation as well, and maintain as required.

Maintaining Good Appearance:

- ✓Keeping equipment clean and protected inside and out will help preserving its appearance and value over time.
- ✓Owner's manual provides great guidance for cleaning and maintaining the various components and materials.
- ✓ Always use recommended cleaning materials (chemicals) or tools.

Maintenance Schedule

- ✓The equipment is designed to perform and last under specific maintenance conditions.
- ✓You can help preserve equipment by following the maintenance schedule present in the owner's manual.
- ✓The schedule is designed with the equipment's continued safety and top performance in mind and is one of the greatest assets to ensure long life of your vehicle.

Maintenance Schedule

Maintenance items	Service time				
	Daily	Weekly	Monthly	6 months	Yearly
Inspection	X				
Check coolant heater	X				
Check coolant level	X				
Check oil level	X				
Check fuel level	X				
Check charge-air piping	X				
Check/clean air cleaner		X			
Check battery charger		X			
Drain fuel filter		X			
Drain water from fuel tank		X			
Check coolant concentration			X		
Check drive belt tension			X		
Drain exhaust condensate			X		
Check starting batteries			X		
Change oil and filter				X	
Change coolant filter				X	
Clean crankcase breather				X	
Change air cleaner element				X	
Check radiator hoses				X	
Change fuel filters				X	
Clean cooling systems					X

Maintenance Log

✓The downloadable maintenance log provides a convenient and useful record of equipment’s service history.

✓ One can keep track of the equipment's service dates and all maintenance performed on the equipment.

Equipment Maintenance Log

Make:	Komatsu
Model:	JK-XZ
Year:	2004
Vehicle ID Number:	XZDS_32456
Engine:	TJ-SS

Total Cost: 155.12

Date of Service	Mileage at Service	Work Performed and Service Schedule	Performed By	Cost	Notes
18/06/2011	8,755	Oil Change, Replace Oil Filter	Jiffy Lube	74.89	
26/03/2012	17,339	Oil Change, Replace Oil Filter General Inspection & Tire Rotation	Jiffy Lube	80.23	
07/06/2012	20,611	A/C Discharge Hose Broken Recall fix: Replace Wiper Rod Arm	Dealer	-	Covered under warranty
	30,000	Oil Change, Replace Oil Filter Air, Cabin Air Filters Tire Rotation Inspect Drive Belts			
	40,000	Oil Change, Replace Oil Filter General Inspection & Tire Rotation			
	45,000	Flush/Replace Brake Fluid			
	50,000	Oil Change, Replace Oil Filter Rotate Tires			
	60,000	Oil Change, Replace Oil Filter			

Planning for heavy equipment operations

- ✓Set up a preconstruction meeting inviting all contractors to discuss ways to coordinate work activities, identify potential hazards, and means to eliminate or reduce them.
- ✓Develop a process for reviewing incidents and close calls.
- ✓Identify hazards and ways to correct them.

Planning for heavy equipment operations

✓Develop diagrams to show how construction vehicles and heavy equipment will enter, move, and leave the work zone

✓Design the workspace so that backing up and blind spots are minimal

✓Establish ways to provide for well-lit work areas.

Traffic Control

✓Prevent unauthorized access to worksite.

✓Establish parking areas for workers and visitors

✓Install barricades or other barriers to clearly delineate traffic routes and prevent vehicles from coming into the work zone

Traffic Control

- ✓Designate a single traffic control person to authorize, monitor, and direct the movement of vehicles including backing up
- ✓Provide alternate routes for workers on foot to access the work area, if possible
- ✓Authorize the traffic control supervisor to temporarily stop work until traffic congestion is under control or eliminated

Pre-start / Walk Around Inspection

- ✓Check for any warning lights, if any such lights on, refer to operator's manual
- ✓Check for loose or worn parts and repair or replace immediately.
- ✓Check all fluid/coolant levels.
- ✓**Caution:** Open the radiator cap only when the engine is cooled.

Pre-start / Walk Around Inspection

- ✓hydraulic line connectors and hoses for leaks before applying pressure to the system. Use paper or cardboard, not your hands, to search for leaks.
- ✓**Caution:** Hydraulic fluid escaping under pressure can penetrate skin and cause serious bodily harm.
- ✓Check tires for cuts, bulges, irregularities, abnormal wear and proper inflation.
- ✓Mount a fire extinguisher and first aid kit in the cab.

Train students and young workers

- ✓Review with them their information on What Can Happen to You and How to Keep Yourself Safe when working around heavy construction equipment
- ✓Hold daily toolbox meetings at the job site to highlight potential dangers of today's tasks. Discuss close calls
- ✓To recognize and avoid the hazards of working on foot around vehicles and heavy construction equipment by staying away and working at safe distances
- ✓To recognize and stay away from the blind spots of heavy equipment and vehicles.

Train students and young workers

- ✓To be alert to potential hazards that may be created by another contractor's employees
- ✓To work within the line of sight of the equipment operator and maintain visual contact with the operator
- ✓To wear high visibility safety clothing including reflective gloves, arm bands, and other accessories. This is critical under poor lighting and bad weather conditions

Work Safer

- ✓Schedule work tasks to keep workers on foot out of areas where heavy equipment and construction vehicles are present whenever possible
- ✓Use sensing units on heavy equipment to detect workers on foot
- ✓Encourage communication, e.g., hand signals, two way radios for employees assigned to watch for safety in the work zone or employees on foot talking to the equipment operator
- ✓Ensure backup alarms, horns on construction equipment are tested daily and function effectively. Instruct equipment operators to use these devices to call the attention of workers on foot

Work Safer

✓Encourage operators of heavy equipment and construction vehicles to:

✓move equipment only after positive visual contact (seeing each other`s eyes) has been made and confirmed with workers on foot

✓always observe jobsite speed limits and reduce speed when workers on foot are nearby

Shut Down and Parking

✓Always Park at the designated place on a level ground.

✓When parking on an inclined surface, position at right angles to the slope, block the wheels and set the parking brakes.

✓When parking, lower all loader, buckets and hydraulics to the ground.

Housekeeping

- Ensure the cab area is clean and free of debris and tools.
- Clean windshield, mirrors and lights.
- Remove all oil, grease, mud or snow from grab irons, hand rails, steps, pedal sand floor to prevent slips and falls.
- Remove or secure any loose items such as tools, chains or lunch boxes from the cab.

Heavy Equipment Selection Process

And for each type the methodology used to analyze the different criteria was based in:

1. Measuring the performance
2. Measuring the minimal risk
3. Measuring the minimal impact or environmental aspect

Heavy Equipment Selection Process

Steps of the selection methodology

CRITERIA	USED METHOD TO ANALYSE IT
Optimum performance	Minimal hourly cost Maximum hourly productivity
Minimal risk	The minimal risk criteria, will be the result from the sum of all the present risks. The valuation of these risks was made through the method proposed by the INSHT. (Instituto Nacional de Seguridad e Higiene del Trabajo).
Minimal impact or environmental aspect	The minimal impact or environmental aspect, will be the result from the sum of all the present impacts. The valuation of these impacts was made through the method of identification and evaluation of environmental impact and aspects based on the Environmental Management Systems contained in the ISO 14001 standard.

Heavy Equipment Selection Process

OPTIMUM PERFORMANCE

1. Measuring the productivity for each of the different types of equipment
2. Hourly costs
3. Factor that influence the performance of construction equipment

a. Routine delays
b. Restrictions to optimal mechanic operation
c. Site conditions
d. Direction and Supervision

Heavy Equipment Selection Process

Equipment Risk Valuation

		Severity		
		LIGHT	HAZARDOUS	EXTREMELY HAZARDOUS
		1	2	6
Low probability	1	Trivial risk 1	Tolerable risk 2	Moderate risk 6
Medium probability	2	Tolerable risk 2	Moderate risk 4 ≈ 6	Important risk 12
High probability	6	Moderate risk 6	Important risk 12	Intolerable risk 36

Heavy Equipment Selection Process

Minimum Risk Criteria

The minimal risk criteria is obtained as follows:

- ✓ Identify and evaluate all the present risks of the equipment, according to the general process of risk evaluation.
- ✓ Valuation of the found risks, by a numeric scale.
- ✓ Finally all the values for each equipment are summed which gives the value of the minimal risk criteria

Heavy Equipment Selection Process

✓ Minimal impact or Environmental Criteria

The minimal impact or environmental impact of construction equipment is obtained as follows:

1. Identification and evaluation of all impacts present on a given equipment applying a descriptive method based on the criteria of an EMS as the ISO standards.
2. Valuation of the encountered impacts according to their criticality.
3. The sum of all the values of specific equipment, this result gives the "minimal impact or environmental aspect

Troubleshooting

Lets get some basics right !

- ✓ **Having correct level of all fluids as required by the manual**
- ✓ **Cleaning the air filters as per manual**
- ✓ **Changing the air filters as required by the manual**
- ✓ **Changing the lubrication oil when required by the manual (correct grade !)**
- ✓ **Changing the lubrication oil filter (buy good quality and correct parts)**

Lets get some basics right !

- ✓ **Cleaning or replacing the fuel filter as require in the manual**
- ✓ **Correct tension for the belts, not too tight or too loose**
- ✓ **Inspecting and changing brake pads**
- ✓ **Inspecting and replacing tires**

Lubrication Oil, your Machines's lifeline

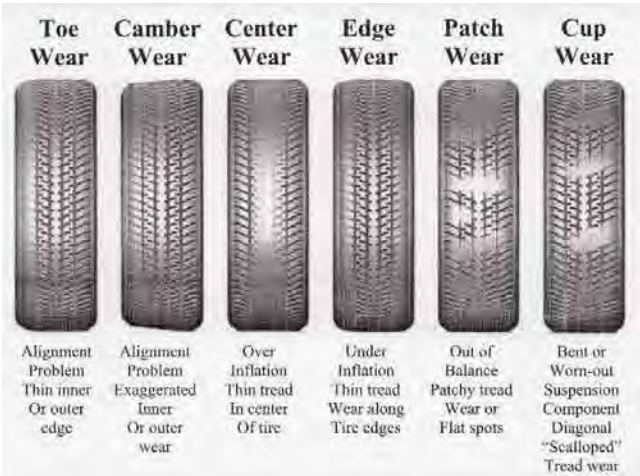
- The most important issue in your equipment's life is selecting the correct oil and changing it regularly.

Lubrication Oil Selection

- **10W40**: The "W" **means** winter. 10 is the thickness rating and is how thick it is at 0 degrees F. The larger the number, the thicker the oil. So 40 is how thick the oil is when the engine is at operating temperature. Yes the oil is THICKER when the engine is hot.

http://www.viscopedia.com/viscosity-tables/substances/sae-viscosity-grades/

Tires and breaks are your lifeline !



- ✓ **Worn out tires are safety hazard**
- ✓ **Proper tire inflation is important for good traction, fuel economy, breaking distance and tire life**

Tire size and pressure

Tire Size	Tire Load Limit and Cold Inflation Pressures			
	Single		Dual	
	Lb.	PSI	Lb.	PSI
215/85R 16E	2,680	80	2,470	80

Break Inspection!

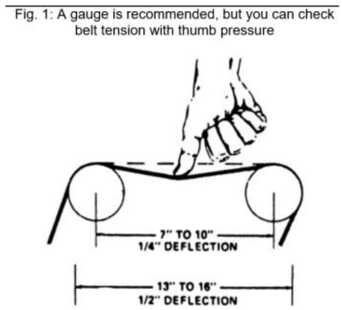
- ✓ **Worn out pads are safety hazard**
- ✓ **changing pads on time can save rotors**

Belts drive your operations !

Worn-out belts

Always buy correct type!

Drive belt tension adjustment

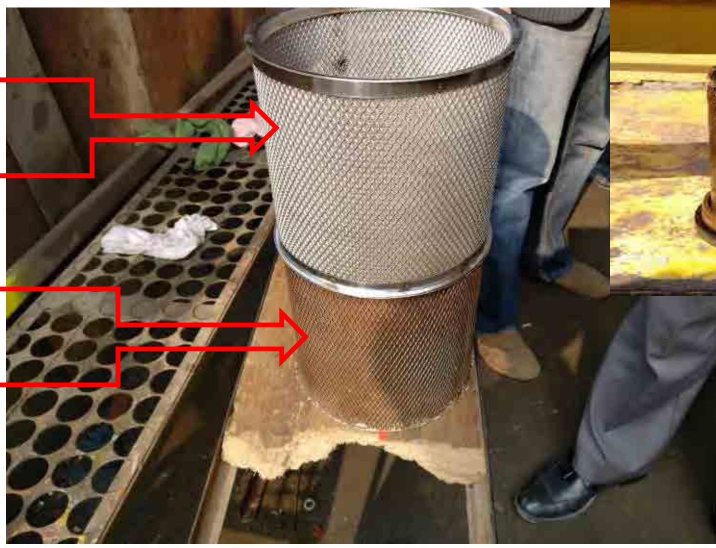


Belt alignment

Filters are lungs for your machines!

Clean Filter

Dirty Filter



Dirty Y Strainer filter

Lessons from OJT

Lessons from OJT

WSD 5231, Mod. 3

167

Lessons from OJT

WSD 5231, Mod. 3

168

Lessons from OJT

Steel Lower Manhole Guide Shoe

Lower Manhole Hose Guide Roller-Grabber

WSD 5231, Mod. 3

169

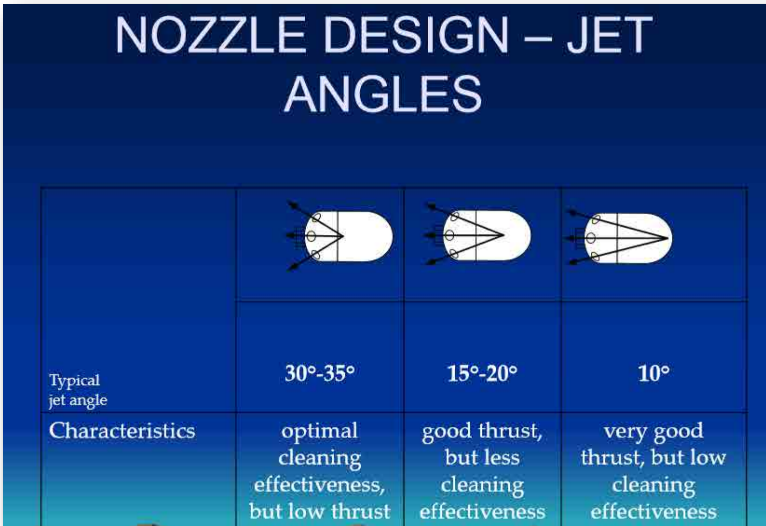
Lessons from OJT

- ✓Correct Material
- ✓Lasts longer
- ✓Better efficiency

WSD 5231, Mod. 3

170

Lessons from OJT



NOZZLE DESIGN – JET ANGLES

Typical jet angle	30°-35°	15°-20°	10°
Characteristics	optimal cleaning effectiveness, but low thrust	good thrust, but less cleaning effectiveness	very good thrust, but low cleaning effectiveness

Wrap-up

Things to take home…

1. Heavy machines drive your operations
2. Always do a root cause analysis
3. Repair is not preventive maintenance
4. Use standard parts and fluids
5. Keep records, always !!!

O & M of Mechanical Equipment
WSD 5231

Water Meter Introduction and Selection

Module 4

Agenda

- ✓ Ice Breaker and Class Introduction
- ✓ Resources and handouts
- ✓ Importance of water meters
- ✓ Types of water meters

Agenda

- ✓ Selection of water meters
- ✓ Installation of water meters
- ✓ Maintenance of water meters

Icebreaker and class introduction

- Importance of water meters in WASA operations
- What do we cover in this module?
- What to expect in this module?
- Goal and objectives of this module?

Icebreaker and Class Introduction

Now it is your turn…

- Degree and backgrounds?
- Share your work experience relative to water meter selection,isntallation & maintenance?

Icebreaker and Class Introduction

Now it is your turn…

- Any prior experience related to water metering?
- Why interested in this module?
- What best skills do you bring to the class?

Resources and Handouts

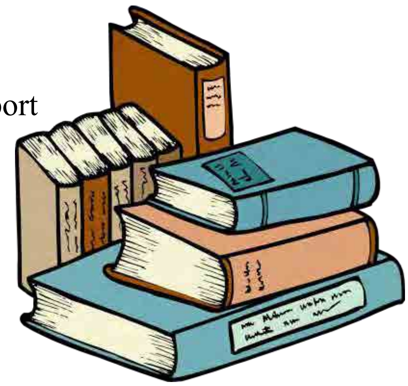
•Lecture notes

•Water meter installation guidelines

•Metering in municipalities - WRC report

•Water meters (various types)

•Water meter major components



Resources and Handouts

•Introduction to Integrated Water Meter Management, Zyl,J. (2011)

•Water meters, Vol.4, Satterfield, Z. (2004)

Water meter overview

- ✓ Water metering is the process of measuring water use.
- ✓ And, the best way for a water utility to measure or account for the water produced and then sold is by using water meters.

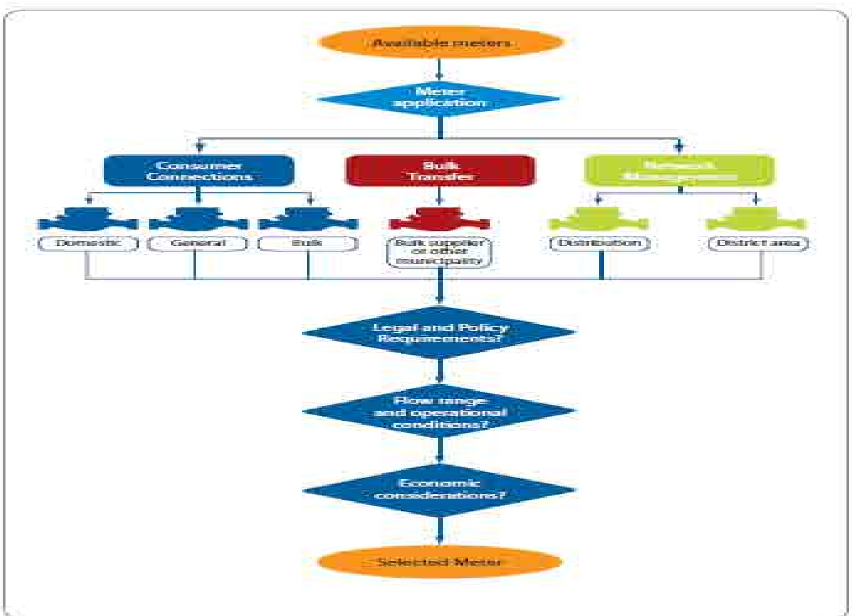
Importance of water meters

- ✓ Water meters are important to a utility for several reasons:
- ✓ Helps in monitoring the volume of finished water
- ✓ Help in water conservation
- ✓ allow the system to demonstrate accountability

Importance of water meters

- ✓ fair for all customers because they record specific usage
- ✓ aid in the detection of leaks and waterline breaks in the distribution system.
- ✓ monitor the volume of consumed water

Water Meter Selection Process Flow Chart



Meter application

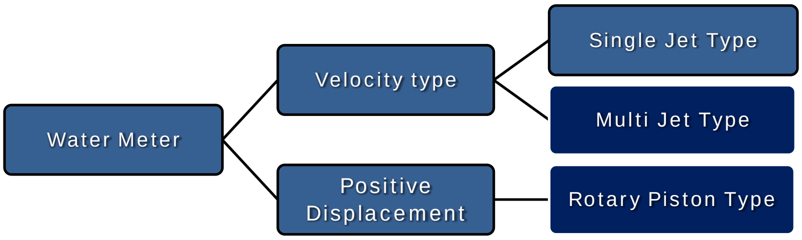
- ✓ Purpose
- ✓ There are three major applications of water meters:

1. Consumer meters
2. Bulk transfer meters
3. Management meters

Management meters

- ✓ Management meters measure the distribution of water to different parts of the network.
- ✓ They are essential for many technical and management functions.
- ✓ Management meters that are not district area meters are collectively called distribution meters.

Major Water Meter Types in WASA (Consumer Meters)




Single Jet Type


Multi Jet Type


Rotary Piston Type

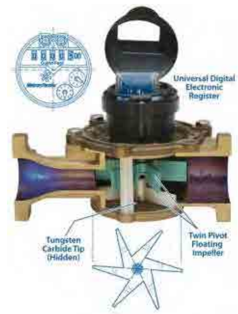
Dry type & Wet type

- The dry type water meter has the reading mechanism hermetically separated from the water flow chamber.
- The transmission to the reading mechanism gears takes place via magnetic coupling between the turbine and the reading mechanism itself.
- The wet type water meters has the reading mechanism the reading mechanism completely immersed in the water and the transmission is direct from the turbine to the gears of the mechanism itself.

Single Jet Type

- The principle of operation is given by the incidence of a single tangential stream of water with a turbine mounted in a radial position within the body of the meter.

- The rotation of the turbine transmits the motion to the reading mechanism allowing the measurement of the volume of water passing through the meter.

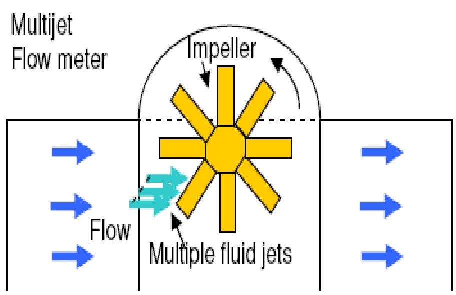


Multi Jet Type

- The principle of operation is to force the passage of the inlet water flow through a series of ducts open in a capsule, called distributor, containing the turbine.
- The entrance of the water through the ducts generates a series of symmetrical jets that impact the turbine keeping it in perfect balance.

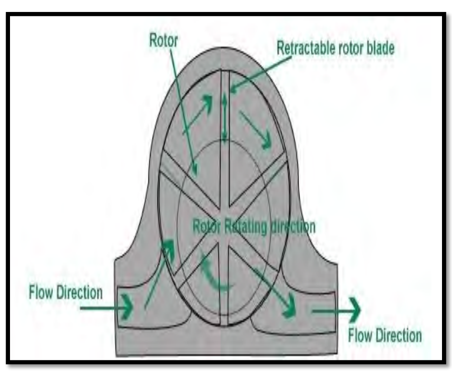
Multi-jet meters

✓ They have tangential openings in a chamber to direct the water flow across a rotor with many vanes.



Piston meters

✓ They have a piston that oscillates back and forth as water flows through the meter.



Oscillating piston meter

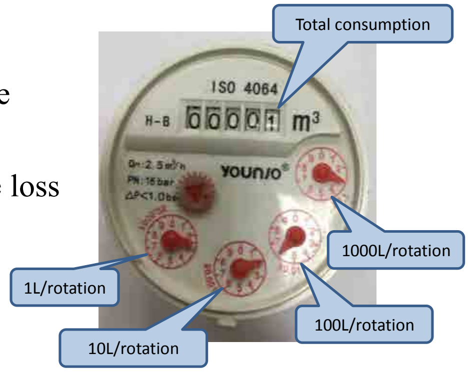
Display of Water Meter

- ISO 4064: 1993

  Qn : Nominal Flow Rate

  PN : Nominal pressure

  △P : maximum pressure loss



Selection Parameters (Consumer Meters)

ISO 4064 :1993

Type	Nominal Dia	Qn [m3/h]	Qmax [m3/h]
Velocity type	13	1.5	3
	20	2.5	5
	25	3	6

Qn : Nominal Flow Rate
Qt : Transitional Flow Rate
Class B_0.08 × Qn Class C 0.015 × Qn
Qmin : Minimum Flow Rate
Class B _0.02 × Qn Class C_0.01 × Qn
Qmax : Maximum Flow Rate
Class B _2 × Qn Class C_2 × Qn

R : Qmax/Qmin
Class B : R=50
Class C : R=100

Other Selection Parameters

- **Material:**

e.g.: All materials in contact with the water passing through the water meter shall be made of materials which are harmless, non-contaminating and biologically inert.

- **Pressure test:**

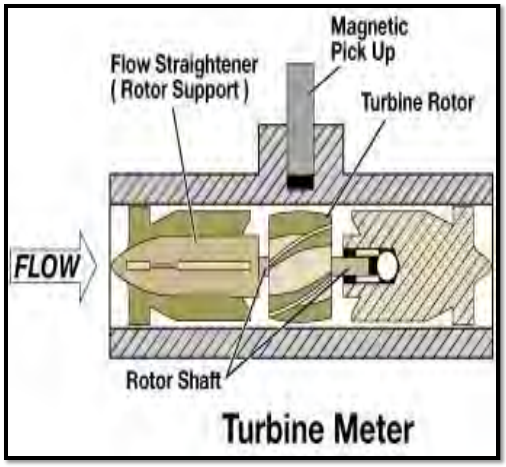
e.g.: The water meter shall conform to the pressure resistance performance.

Comparison of water meters

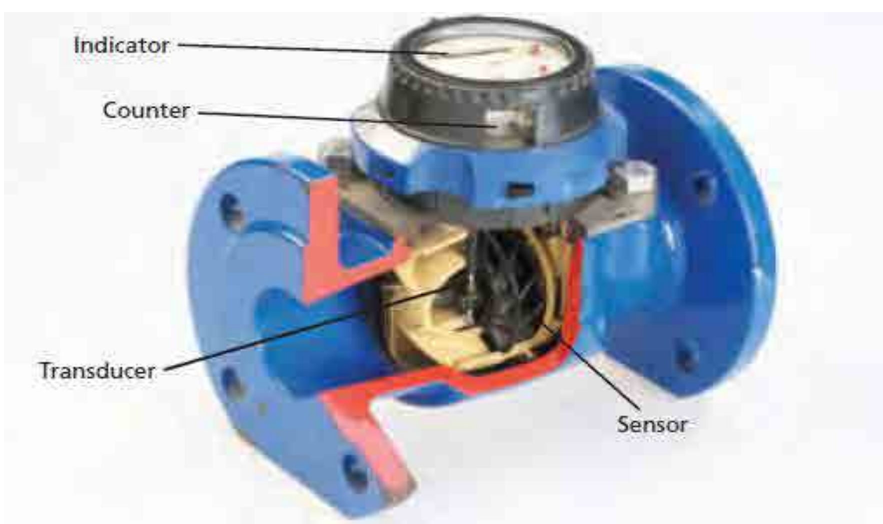
	Single jet (dry)	Multi jet (wet)	Rotary piston (wet)
Appearance			
Measuring method	Velocity	Velocity	Positive displacement
Structure	Simple structure	Complicated than Single jet	Complicated than others
Cost	Inexpensive	Inexpensive	More expensive than others
Others	Highly reliable operation	Small amount of water can be accumulated accurately	High accuracy than others

Turbine meter

- ✓ These meters have a rotating element that turns with the flow of water.
- ✓ Volume of water is measured by the number of revolutions by the rotor.

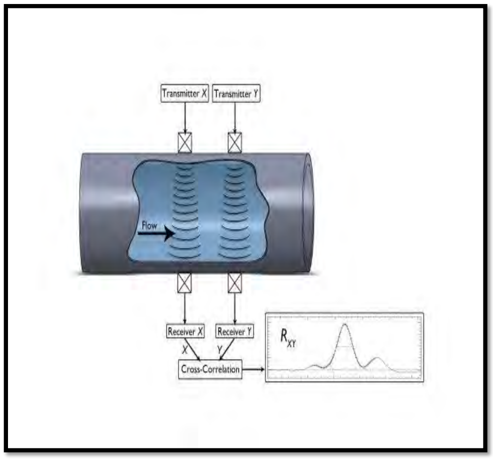


Section through a flow meter showing the sensor, transducer, counter and indicator (meter supplied by Sensus)



Ultrasonic meters

- ✓ They work by sending sound waves diagonally across the flow of water in the pipe.
- ✓ Changes in the velocity of water are converted electronically to change in flow rate.



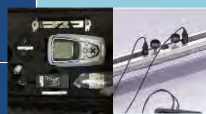
Ultrasonic meter

Magnetic meter

- ✓ They have an insulated sec through which water flows.
- ✓ The flow of water induce: electrical current that proportional to the velocity hence the flow rate.

Magnetic water meter

Comparison of Flow meters

	Ultra Sonic	Electromagnetic	Turbine
Appearance			
Accuracy	in small flow rate		in small flow rate
Installation condition (D:pipe dia)	Before meter:10D After meter:5D	Before meter:5D After meter:2D	Before meter:10D After meter:5D
Pressure loss	No pressure loss	Almost no pressure loss	Pressure loss due to around Impeller
Telecommunications	Available	Available	Available
Initial Cost	Expensive	Expensive	Inexpensive
Others	Proper installation skill is required	Susceptible to electrical noise	There is lifetime of rotation parts

Water meter installation

- ✓ Its important to install a meter in right spot
- ✓ In case of a private water service i.e.:

i. inside the front property boundary (inlet riser: b/w 300mm & 1000mm)

ii. from the left or right property boundary (inlet riser: b/w 300 & 600mm).

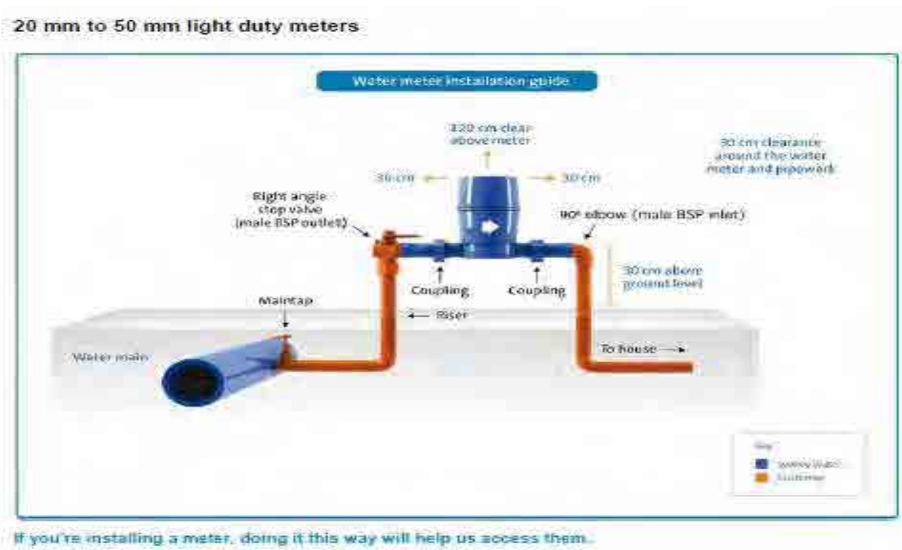
iii. and outlet riser are 300 mm from the ground

iv. and outlet riser are parallel to the closest side boundary

Water meter installation

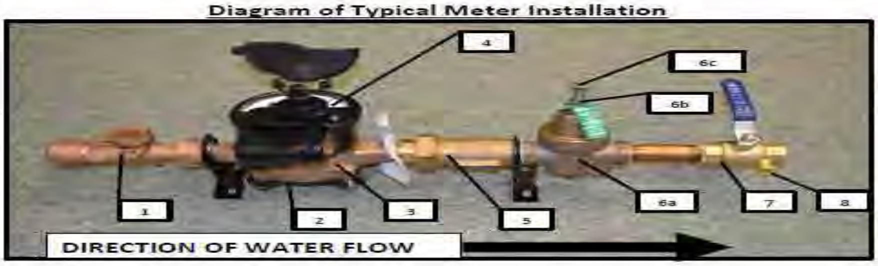
- ✓ If you're installing meters close together, you must allow 300 mm between them.
- ✓ You must not install the meter
- ✓ more than 1.5 metres above the ground

Spacing required in installation



Water Meter Installation Schematic for cold environments (source: Lambton Shores municipality)

Diagram of Typical Meter Installation



#	Meter Assembly Component
1.	Isolation Valve (attached to waterline from street)
2.	Water Meter Frost Plate (sacrificial black steel, under meter, will break if frozen)
3.	Water Meter Base
4.	Water Meter Register Head
5.	Dual Check Backflow Preventer (DuC)
6a.	Pressure Reducing Valve (PRV)
6b.	Pressure Reducing Valve Lock Nut (hexagonal nut)
6c.	Pressure Reducing Valve Operating Bolt (threaded bolt with hexagon head)
7.	Residential Isolation Valve (connects to household plumbing)
8.	Drain Port (for winterizing plumbing) (not included in a pit meter assembly)

These are the generic components to a water meter assembly in Lambton Shores. There are variations of older style valves but all operate similarly.

Water meter maintenance

- ✓ Proper maintenance of metering device is essential for its operation.
- ✓ A municipality should develop a water meter maintenance programme.
- ✓ Water meter maintenance requires actions, such as cleaning of strainers, cleaning and repair of meter boxes, fixing leaks, register covers.

Inspection Checklist

- ✓ A checklist should be developed for use by meter inspectors in the field. This checklist should include the following information:
  - ✓ Location and date.
  - ✓ Inspector's name.
  - ✓ Meter identification: make, model, size, serial number and current reading.
  - ✓ Condition of meter installation: meter body, meter register, pipe work, leakage, upstream valve, downstream valve, meter chamber, strainer, signs of unauthorised connections and other.
  - ✓ Actions taken: strainer cleaned/replaced, meter mechanism inspected and/or valve operation checked.
  - ✓ Action required: cleaning, chamber repairs, meter test and/or leak repairs.

Problems related to metering

- ✓ Suspended solids get stuck in it & causes meters damaging.
- ✓ Meters buried under soil and vegetation
- ✓ Due to high TDS (total suspended solids) lime or metal oxide deposits in meters.
- ✓ Consumer complaints of suspected meter errors

Meter almost buried in the soil

Problems related to metering

- ✓ Leakage from meter connections.
- ✓ Damage to meters due to high velocity air flow when drained pipes are refilled.
- ✓ Vandalism to meters for scrap metal or in anger, often in 'retaliation' when indigent consumers are cut off

Leakages from meter connections

Problems related to monitoring

- ✓ Strainers to get clogged. These solids enter the system most often due to:
  - ✓Large pipe bursts.
  - ✓Mineral
  - ✓Corrosion
  - ✓Inadequate water treatment or malfunctioning treatment plants.

Pipe leakages causes the system to get clogged

添付資料 3.46

2017 年春期研修「Business Planning」の教材

MODULE - 1

Day-1 Session-1

Introduction of Business Planning Course

Muhammad Kashif
Municipal Financial Specialist

ALJAZARI ACADEMY

PROJECT

1

Project for Improving the Capacity of WASAs Staff and Water Sector Service Providers in the Pakistan

ALJAZARI ACADEMY

BENEFIT MORE FROM THE COURSE

2

- **BE ON TIME** for each session
- **LISTEN** to understand, not to contradict
- **REFLECT** and think through what you hear
- Enhance your understanding by **ASKING QUESTIONS**
- Volunteer to **SHARE YOUR VIEWS** and experience
- **LET OTHERS** have a chance to speak
- **RESPECT** the views of others
- Challenge the ideas, **NEVER THE SPEAKERS**

BENEFIT MORE FROM THE COURSE

3

- **DISAGREE AGREEABLY**, if you must disagree
- **ASK YOURSELF** how the new knowledge can be used
- Respect the **NON-SMOKING RULES** within the building
- Help to keep the building **CLEAN**
- **SWITCH OFF** mobiles phones during the session
- Participants will **MARK ATTENDANCE** in both sessions.

COURSE EVALUATION

4

		Marks	Evaluation Marks
Module 1:	SWOT and GAP Analysis Report	10	
Module 2:	Performance Improvement Plan	20	
	(Project Cost & Prioritization)		
	Communication Plan	10	
Module 3:	Training Plan	10	
Module 4:	Revenue Improvement Plan	10	
Module 5:	Business Plan	40	
		100	**80%**
Attendance	(1 Marks for each day)		**10%**
Class Participation			**10 %**

Please Note:

Participants with active participation, maintaining 80% attendance and passing their activities with at least 70% score will be awarded certificates.

TRAINING EVALUATION

5

Purpose
To determine the quality of delivered content, trainers' quality, and overall learning experiences during the training

Form A Course Evaluation

Form B Trainer Evaluation

Participants are required to share their true feelings and ideas. Provide recommendations for further improvement.

COURSE TEAM

6

JICA Expert

Course Leaders

Mr. Yasuyuki Kuroda
Water Utilities Management Expert

Mr. Muhammad Kashif
Municipal Finance Specialist

Engr. Abid Shah Hussainy
Senior Capacity Development Specialist

Course Team

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Curriculum Design Specialist
M.Phil Teacher Education and Charles Wallace Fellow

Engr. Rao Ali Raza
Senior Research Analyst
Electrical Engineer

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Ph.D Scholar (GIS/RS)

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CA, Finalist and MBA

Ms. Aneeqa Azeem
Research Analyst
M.Phil Environment Sciences

ALJAZARI ACADEMY

COURSE OVERVIEW

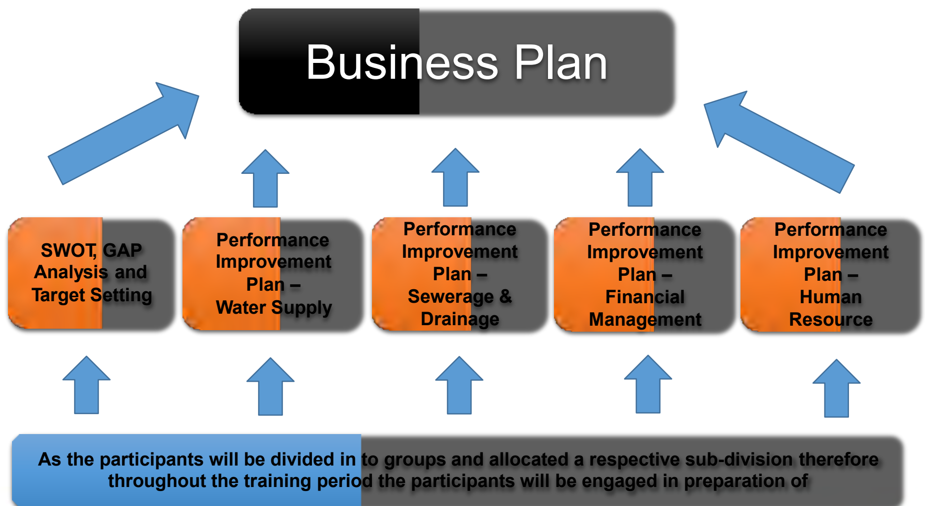
7

MODULE	DETAILS
1: Business Planning and GAP Analysis	Lectures
2: Strategies for Service Delivery Improvement	Individual Assignment
3: Strategies for Human Resource Development	Group Assignment
4: Strategies for Financial Management System Improvement	Simulation Exercise
5: Implementation of Business Plan	Case Studies
	Videos
	Role Play

ALJAZARI ACADEMY

COURSE OUTCOME

8



Form B-01: EXPECTION FROM COURSE

9

Each Class Participant is requested to fill the following form (5 Minutes)

Business Planning Course	
Expectation of Class Participants	
Name:	
Designation	
Organization	
Expectation from this Course	
1.	
2.	
3.	
4.	
5.	

10

REALITY CHECK

GOOD PERFORMANCE AMOUNG PUBLIC WSS UTILITY

Source: Characteristics of Well Performing Public Water Utilities, Water Supply & Sanitation Working Notes, World Bank, 2006

11

REALITY CHECK

GOOD PERFORMANCE AMOUNG PUBLIC WSS UTILITY

Reform Process is **INHERENTLY POLITICAL** and requires the Full Commitment of its Policy Makers to correctly balance Financial & Political Objectives

Success is often Unattainable without reforming the **EXTERNAL ENVIRONMENT** with emphasis on the role of **OWNER**

Fundamental Reforms are **NOT A QUICK FIX** and cannot be substituted by Private Sector Participation.

CERTIAN DECISIONS must be left to Utility Managers

CUSTOMERS AND HUMAN RESOURCE can be an important voice for improving performance

Source: Characteristics of Well Performing Public Water Utilities, Water Supply & Sanitation Working Notes, World Bank, 2006

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MODULE 1: OVERVIEW

1) **Learning Outcomes**
2) **DAY 1**
   a) Session 1: Introduction to Business Planning
   b) Session 2: Business Plan and SWOT Analysis
   c) Session 3: GAP Analysis through SWOT Technique
3) **DAY 2**
   a) Session 1-3: GAP Analysis and Target Setting

13

LEARNING OUTCOME

1) **Knowledge Outcome:**
   a) Identify **Components** of Business Plan
   b) Understand the **SWOT Analysis** concept.
   c) Understand the **KPIs** of WSS Utilities
2) **Skill Set Outcome:**
   a) **GAP Analysis** through Qualitative and Quantities Data
   b) **Target Setting** on the basis of GAP Analysis
3) **Professional Attitude Outcome:**
   a) **Logical and Analytical thinking**
   b) **Team Work**

13

INTRODUCTION OF BUSINESS PLANNING COURSE

THANK YOU

Business Planning B1131 Module 1 : Business Planning and GAP Analysis Session 1

BUSINESS PLAN AND ITS COMPONENTS

14

What is a Business Plan?

Source : www.gov.scot/Resource/0048/00485457.pdf assessed on 4th Jan 2016

The Business Planning as defined by International Benchmarking Network for Water and Sanitation Utilities in "The IBNET Water Supply and Sanitation Performance Blue Book" is defined as

"A business plan presents a detailed roadmap that can guide a utility from its current condition to a desired future state"

Business Planning B1131 Module 1 : Business Planning and GAP Analysis Session 1

BUSINESS PLAN AND ITS COMPONENTS

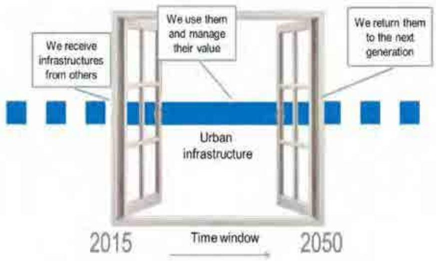
15

Mission and Vision

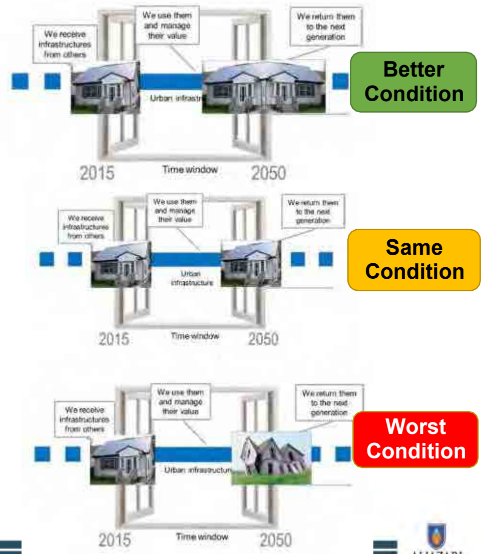
Mission: Where do we need and want to be?

Vision: How do we get there?

Strategy: **"**How much" of "what" will be accomplished by "When"?



Source : "Integrated Planning of Urban Water Service: A global approach" Manual 1 by European Union Seventh Frame Programme



BUSINESS PLAN AND ITS COMPONENTS

16

Strategies and Action Plan

Strategy:	Action Plan:	KPIs:
"How much" of "what" will be accomplished by "When"	What change will happen, who will do what and when to make it happen	The yardstick to measures the objectives

Strategy	Details	Action Plan				KPIs
		Details	Responsible Official	Start	End	
Metering up to 20%	New Metering Program	Awareness Companign	Dy Director Admin	Jan-17	Jan-18	Metering Level
		Procurement of Meters for consumers	Dy Director Procurement	Jan-17	Jun-17	
		Installation of Meters	Dy Director O&M	Jun-17	Dec-17	

Source : http://ctb.ku.edu/en/table-of-contents/structure/strategic-planning/vmosa/main

BUSINESS PLAN AND ITS COMPONENTS

17

Vision/Mission of International WSS Utility

PUB SINGAPORE'S NATIONAL WATER AGENCY

Vision:
Water for All: Conserve, Value and Enjoy

Mission:
To ensure an efficient, adequate & sustainable supply of water

Source : https://www.pub.gov.sg/about/missionvision

Yokohama Water

Vision:
To be a leading company on water solution in Japan

Mission:
To provide better quality service of water supply and sewerage to the world society

Source : http://yokohamawater.co.jp/en/company.php

CAN WE COLLECT OBJECTIVE AND STRATEGIES FROM THE VISION AND MISSION

Strategies:

"How much" of "what" will be accomplished by "When"

BUSINESS PLAN AND ITS COMPONENTS

18

What is the Vision/Mission of your WSS Utility?

WASA LAHORE

FUNCTIONS

WASA is an agency of LDA and is responsible for:

Planning, Designing and Construction of Water Supply, Sewerage & Drainage facilities for:

- New Works
- Rehabilitation and Augmentation of the existing system

Opertaion and Maintenance of Water Supply, Sewerage & Drainage System.

Billing and Collection of all rates, fees and charges for the services provided to Consumers.

Contents

VISION

WASA Lahore to be quality service providing utility, exceeding consumers' expectations through dedicated employees committed to excellence.

Contents

MISSION

WASA Lahore would contribute towards making Lahore city cleaner and environment friendly.

- Offering quality consumer services in the field of Water Supply and Sewerage.
- Ensuring cost effective measures in Development works and operation & maintenance.
- Adhering to professional ethics and zero tolerance for corruption.
- Revenue generation at least sufficient to meet with the non development expenditure and to make the system self sustainable.

Source : http://wasalahore.page.tl/Functions,-Vision-and-Mission.htm

WASA RAWALPINDI

Objectives

The Water and Sanitation Agency's objectives are defined as follows:

- To support ecologically sustainable development and to meet the community needs through the provision and maintenance of effective services.
- To provide high quality water supply complying with recognized drinking water standards and to transport and treat sewage for disposal to meet the City's environmental standards.

Our Customer
To effectively anticipate and to respond appropriately to customer needs.

Our Environment
To maintain sustainability of the Rawalpindi environment and to the sustainability of the wider environment.

Our People
To establish and maintain productive and valued staff.

Our Assets
To apply best practice in operating and maintaining our assets.

Our Finances
To maintain the WASA as a competitive and financially responsible and accountable entity.

Our Sustainability
To manage the business to be commercially successful in the longer term.

Our Accountability
To demonstrate accountability to all stakeholders.

Functions

- Provision and O&M of Water Supply
  (i). Source: Rawal Lake Filtration Plant, Khanpur Dam, Tomar Service Reservoir and Tubewells.
  (ii). Distribution Network including Water Works
- O&M of Sewerage System and related Appurtenance Billing and Revenue (water charges) collection to attain Financial Sustainability.
- Enforcement against Defaulters / Unauthorized Connections etc.
- Short Term and Long Term Planning for Tapping Additional Water Sources & Implementation to meet water supply and Sewerage demand projected on the period. The long term Projects are:
  (i). Rawalpindi Environmental Improvement Project (ADB Funded Project)

Source: http://www.wasa.rda.gov.pk/AboutUs.htm

BUSINESS PLAN AND ITS COMPONENTS

19

What is the Vision/Mission of your WSS Utility?

WASA FAISALABAD

The Vision

To be an extraordinary service provider for the citizens of Faisalabad and thereafter to be the Centre of excellence in water sector of the country.

The Mission

To make our customers feel welcome, appreciated, and worthy of our best efforts in everything we do for providing water supply, sewerage and drainage services.

Source:
http://wasafaisalabad.gop.pk/Home/WASAProfile

WASA MULTAN

MISSION

1. Improvement of service level of existing Water Supply and Sewerage facilities.
1. Extension of these facilities for entire population of the City including newly developed areas.
1. Improvement of recovery of user charges to make it the self-financing Agency.

Functions

* Forecasting of demand for services of Water Supply, Sewerage and Drainage, preparation of plans and design for their extension, rehabilitation and replacement.
* Construction, Improvement, Maintenance and Operation of Water Works, Sewerage Works and Main Storm Water Drainage Channels, and Pumping Stations.
* Billing and collection of all rates, fees and charges, for the services so provided to the consumers.

Source:
http://www.multan.gov.pk/page.php?data=60qa

ALJAZARI ACADEMY

BUSINESS PLAN AND ITS COMPONENTS

20

What is the Vision/Mission of your WSS Utility?

WASA GUJRANWALA

The Vision

To be an extraordinary service provider for the citizens of Multan and thereafter to be the Centre of excellence in water sector of the country.

The Mission

To make our customers feel welcome, appreciated, and worthy of our best efforts in everything we do for providing water supply, sewerage and drainage services.

Source: http://www.wasag.gop.pk/Home/WASAProfile

North Sindh Urban Services Corporation Limited

Vision

To be a leader in sustainable water supply, sewerage and solid waste management, delivery of quality customer services.

Mission: Core Purpose

To deliver sustainable water supply, sewerage and solid waste services in a safe, efficient and effective manner.

Source: http://www.nsusc.org.pk/frmGeneralPage.aspx?MID=1&PageTitle=About%20Us

ALJAZARI ACADEMY

BENCHMARKING AND KPI

21

CONCEPT - Benchmark and Indicator

Thermometer indicates the Degrees Of Temperature - **INDICATOR**

98.6°
Normal Body Temperature - **BENCHMARK**

DEFINITION – Benchmarking in WSS Utilities

"Benchmarking is a tool for performance improvement through systematic search and adaptation of leading practices"

Source : Benchmarking Water Services – Guiding Water Utilities to Excellence by International Water Associations and American Water Works Associations

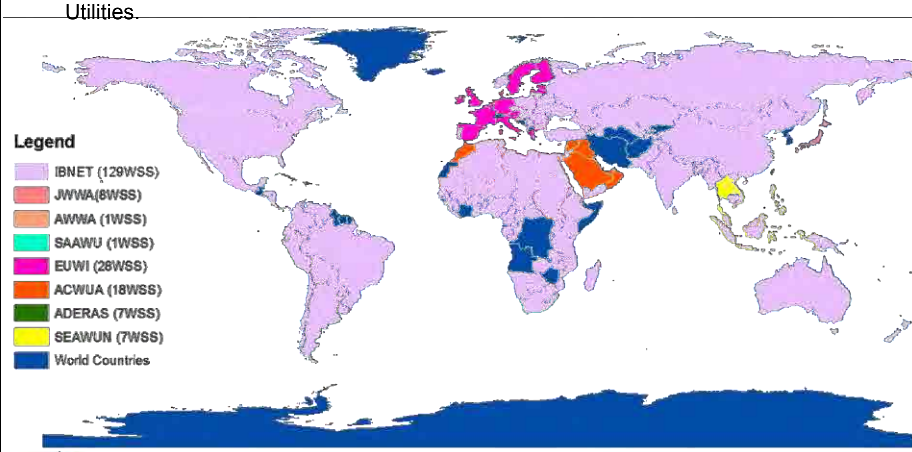
ALJAZARI ACADEMY

BENCHMARKING AND KPI OF WSS UTILITIES

22

International Practice of Benchmarking

Around **160** Benchmarking Initiatives associated with about **700** Water and Sanitation Utilities.



Source: "Water Utility Benchmarking" Measurement, Methodologies and Performance Incentive by IWA Publishing

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Business Planning B1131 Module 1 : Business Planning and GAP Analysis Session 1

BENCHMARKING METHODOLOGY

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1 2 3 4 5

Organize a Benchmarking Team | Do your WSS Utility has notified the team?

NOTIFICATION

The Competent Authority is pleased to endorse and notify Action Plan prepared by WASA Rawalpindi on the subject as per DLIs.

Directorate of Planning will be responsible directorate to monitor and implement the action plan and its activities in coordination with other departments of WASA.

Raja Shaukat Mehmood
Managing Director, WASA

Copy to:
1. The Urban Unit
2. All WASA Concerned staff
3. Office File.

4 Key Performance Indicator & Benchmarking

The WASA Rawalpindi as per notified Indicators by HUD&PHED has adopted the KPI for Bench Marking and Reporting.

Designation of focal person & team:

- Director Planning is the focal person for the whole activity
- The focal person will directly report to the MD of WASA.

Broad TORs of the focal person are:

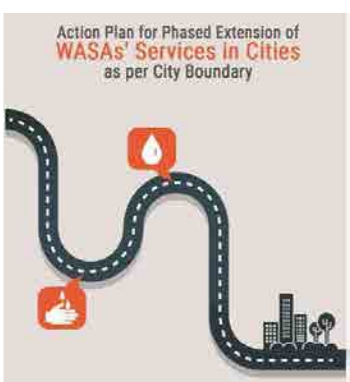
a) Constitute a team of staff members within WASA for his assistance
b) Develop a six monthly activity plan with team and get it approved by MD
c) Develop a process and strategy for data generation against agreed indictors
d) Establish a new robust filing system to track all record when required
e) Establish a mechanism of coordination with stakeholders
f) Take lead role in analyzing the periodic data, comparison with previous data and recommendations

BENCHMARKING METHODOLOGY

24

1 2 3 4 5

Identify Objective | Do your WSS Utility has identified objectives ?



The Objective of the Phase Action for Resource Planning is;

1. Develop a system of resource planning in WASA Multan
2. Set up an organizational arrangement at Planning Department with responsibilities and resources to plan for resources and phase extension of services
3. Plan for phase extension for service delivery
4. Monitors the condition and requirement of service delivery of assets
5. Report compliance to HUD&PHED and stakeholders
6. Improve service delivery

BENCHMARKING METHODOLOGY

25

1 2 3 4 5

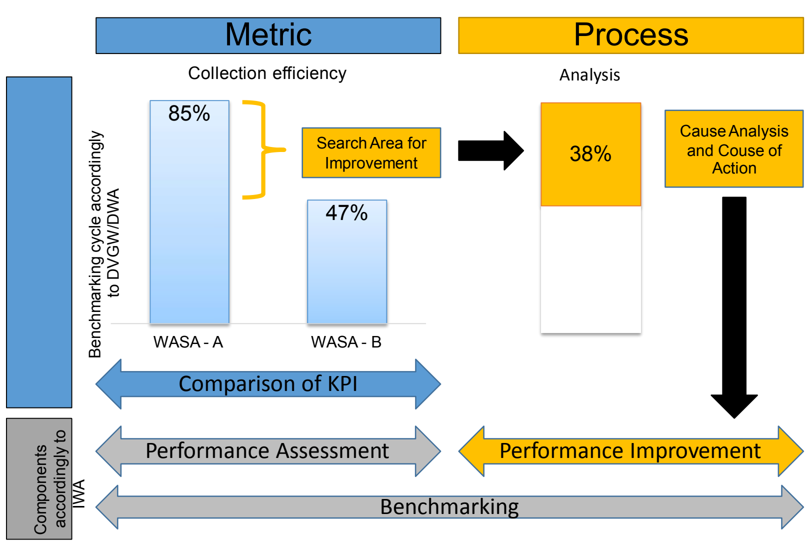
Select Types

TYPES OF BENCHMARKING

Metric	Process
• Numerical measurement of performance levels • Comparison with other WSS utilities • Identify areas for improvement	• Identify the key processes and learn best practices

TYPES OF BENCHMARKING

26



Source: http://www.slideshare.net/BorisavMilutinovic/benchmarking-and-performance-indicators-borisav-milutinovic
Benchmarking cycle according to DVGW and DWA (2008)

TYPES OF BENCHMARKING

27

Tick (√) the type of Benchmarking from the following:

Sr No.	Benchmarking	Metric	Process
1	Water Service Coverage (%)		
2	Arrear Recovery Strategy		
3	Energy Management Plan		
4	Water Production (lpc)		
5	Pipe Breakage (km)		
6	Revenue Collection Mechanism		
7	Metering (%)		
8	Assets Management Process		
9	WSS Staff per 1000 connections		
10	Operating Ratio		

ALJAZARI ACADEMY

BENCHMARKING METHODOLOGY

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1 → 2 → 3 → 4 → 5

Collect Data

What kind of Data is to be collected?

Performance Indicators

International Water Associations – IWA

Six (6) Categories
Forty Seven (47) Sub-Categories

Economic Regulator of Water Sector in England and Wales – OFWAT

Four (4) Categories
Nineteen (19) Sub-Categories

International Benchmarking Network for Water and Sanitation Utilities – IBNET

Eleven (11) Categories
Ninety One (91) Sub-Categories

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KEY PERFORMANCE INDICATORS

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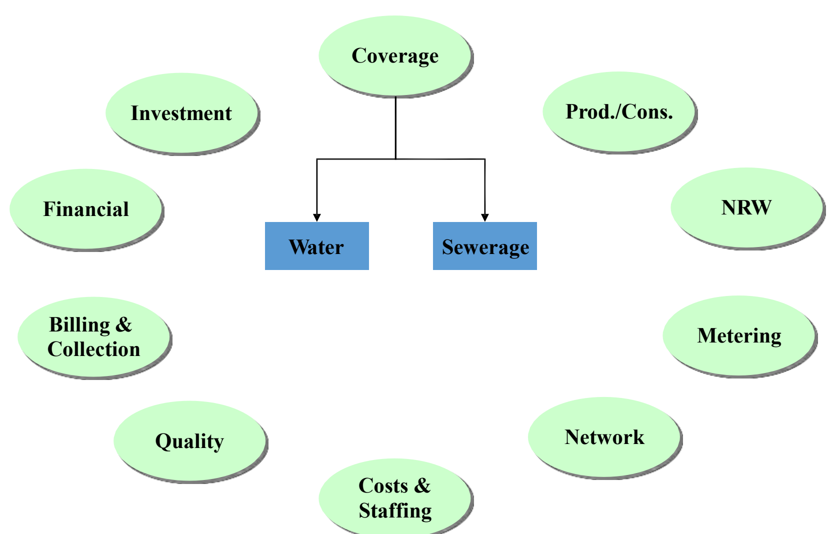
Notified Thirteen (13) Key Performance Indicators by

Planning and Development Department, Government of Punjab

- Water Supply Coverage (%)
- Sewerage Coverage (%)
- Duration of Water Supply (Hrs.)
- Water Production (lpcd)
- Waste Water Collected (m^3 per day)
- Non-Revenue Water (%)
- Water Quality (at production and Consumer end)
- Assets Condition above average (% as per survey)
- Power Factor of Assets above 95% (% of total assets)
- Complaint resolved (% of each town)
- Revenue Collection Efficiency (%)
- Water Supply Pressure (bar)
- Operational Assets Management System (%)

KEY PERFORMANCE INDICATORS

30



KEY PERFORMANCE INDICATORS

31

Water Coverage

Definition:

*"Population with access to water services (either with direct service connection or within reach of a public water point) as a percentage of the total population under utility's nominal responsibility"**

Unit: Percentage

Formula:

$$\frac{\text{Population served with water supply}}{\text{Total population in WSS Service Area – Water}} \times 100$$

Sewerage Coverage

Definition:

"Population with sewerage services (direct service connections) as a percentage of the total population under utility's notional responsibility"

Unit: Percentage

Formula:

$$\frac{\text{Population served with sewerage services}}{\text{Total population in WSS Service Area – Sewerage}} \times 100$$

Population served with WSS services?

1. Residential Houses
2. Hotels
3. Hospitals
4. Commercial Markets & Shops
5. Industries
6. Government Office & others……….

Source : http://www.ib-net.org/en/texts.php?folder_id=101&mat_id=82&L=1&S=2&ss=1

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KEY PERFORMANCE INDICATORS

32

Water Coverage

Definition:

*"Population with access to water services (either with direct service connection or within reach of a public water point) as a percentage of the total population under utility's nominal responsibility"**

Unit: Percentage

Formula:

$$\frac{\text{Population served with water supply}}{\text{Total population in WSS Service Area – Water}} \times 100$$

Where,

Population served with water supply = ((A+B)×C)+D+E+(G-F)

Ref.		Particular
5.4(d)	A	Water residential connections – metered
5.4(g)	B	Water residential connections - unmetered
2.4	C	Household size
2.5	D	Population served – public water points
2.7	E	Population served – direct water supply
2.6	F	Population without water and Wastewater services
2.3(a)	G	Total population in W & S operator area of responsibility – water supply

Sewerage Coverage

Definition:

"Population with sewerage services (direct service connections) as a percentage of the total population under utility's notional responsibility"

Unit: Percentage

Formula:

$$\frac{\text{Population served with sewerage services}}{\text{Total population in WSS Service Area – Sewerage}} \times 100$$

Where,

Population served with sewerage services = ((A×B)+C+(E-D)

Ref.		Particular
6.5(a)	A	Sewer residential connections
2.4	B	Household size
2.8	C	Population served – Wastewater services
2.6	D	Population without water and Wastewater services
2.3(b)	E	Total population in W & S operator area of responsibility – Wastewater

Source : http://www.ib-net.org/en/texts.php?folder_id=101&mat_id=82&L=1&S=2&ss=1

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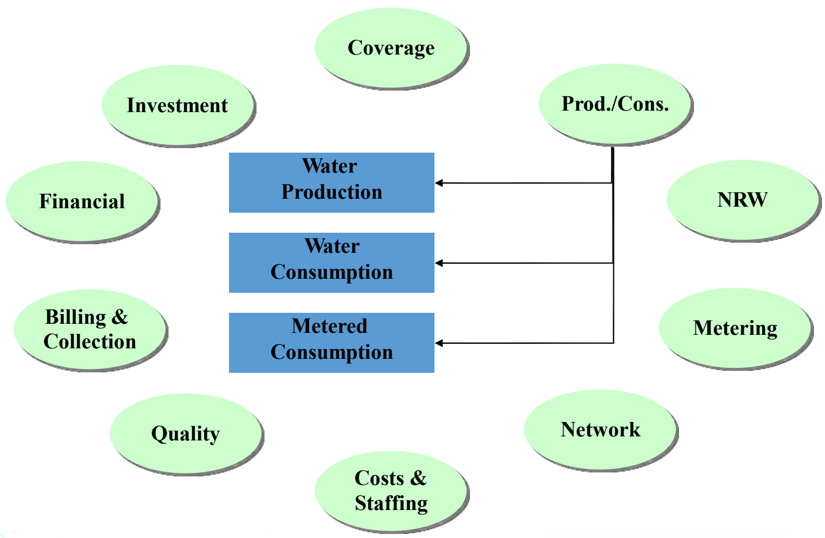
Business Planning B1131 Module 1 : Business Planning and GAP Analysis Session 1

KEY PERFORMANCE INDICATORS

33



KEY PERFORMANCE INDICATORS

34

Water Production

Definition:

"*Total water supplied to the distribution system (including purchased water, if any) expressed by population served per day*"*

Unit: Liters per Capita per Day (lpcd)

Formula:

$$\frac{\text{Total Water Production (Litres)}}{\text{Population served with water supply} \times \text{Nos. of Days}}$$

Total Water Production (Litres)?

1. **No-Bulk Water Meters Installed**
2. **Bulk Waters Installed – Non Functional**
3. **Bulk Waters Installed – Functional**

Source : http://www.ib-net.org/en/texts.php?folder_id=101&mat_id=82&L=1&S=2&ss=1

KEY PERFORMANCE INDICATORS

35

Water Production

Definition:

"*Total water supplied to the distribution system (including purchased water, if any) expressed by population served per day*"*

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Formula:

$$\frac{\text{Total Water Production (Litres)}}{\text{Population served with water supply} \times \text{Nos. of Days}}$$

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2.5	D	Population served – public water points
2.7	E	Population served – direct water supply
2.6	F	Population without water and Wastewater services
2.3(a)	G	Total population in W & S operator area of responsibility – water supply

4.7	H	Water meter reading (closing)
4.6	I	Water meter reading (opening)
4.10	J	Volume of water produced with bulk meter
4.11	K	Volume of water produced
	m	Total no. of tubewells with operating bulk meters
	n	Total no. of tubewells without operating bulk meters
	o	Total no. of surface water sources

Source : http://www.ib-net.org/en/texts.php?folder_id=101&mat_id=82&L=1&S=2&ss=1

BENCHMARKING METHODOLOGY

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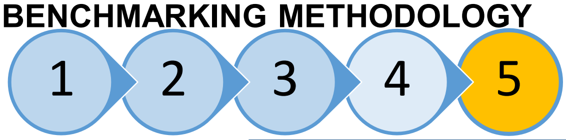

Verify Data	Confidence in data (Confidence Band)
• Missing Data? • Confidence in Data?	1. Data derived from different sources 2. Reliability of the sources

Band	Description
A	Based on reliable records, procedures, investigations or analyses, that are properly documented and recognized as the best available
B	Generally as in band A, but with minor shortcomings, e.g. some documentation is missing, the assessment is old, or some reliance on unconfirmed reports or extrapolation is made
C	Extrapolation from a limited sample for which Band A or B information is available
D	Based on the best estimates of utility staff without measurement or documented evidence

Source: http://www.ib-net.org/en/texts.php?folder_id=118

BENCHMARKING METHODOLOGY

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1 2 3 4 5

Verify Data | Confidence in data (Confidence Band)

DATA FOR KHAIRPUR

Ref	Data Item	Comment	Unit	Input	Confidence	Source
Water service						
40 ☺	Population served	Population *under responsibility of the utility* with access to water through house connections, yard taps and public water points (either with direct service connection or within 200m of a standpost). Any population outside the utility's area of responsibility who are served (e.g. people who come from outside to the Utility's water points) should be excluded.	'000 inhabitants	**24.8**	**D**	**Operating Plan**
40a ☺	Population served – direct supply & shared taps	Population under responsibility of the utility with access to water through house connections and shared yard taps (where 2 or more houses share a private yard with a tap).	'000 inhabitants	**22.3**	**D**	**Estimated**
40b	Population served – public water points	Population under responsibility of the utility with access to water through public water points.		**2.5**	**D**	**Estimated**
41 ☺	Number of water connections	Number of active water connections at year-end. All active connections should be counted – residential, non-residential etc - but inactive connections to vacant buildings should be excluded.	'000	**3.6**	**D**	**Operating Plan**

CONFIDENCE BAND

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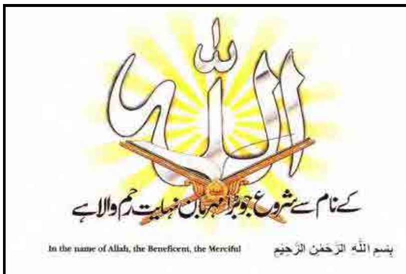
Reading from Bulk Water Meter and Log Book of Tube well has a Confidence Band of:

A B C D

1



Business Planning & GAP Analysis

BUSINESS PLANNNING COURSE : GAP ANALYSIS AND TARGET SETTING

Abid Hussainy
Senior Specialist

ALJAZARI ACADEMY

WHY BUSINESS PLANNING ?

Brain storming ?

What is business planning

When did I hear this phrase ?

Did U participate in Business Planning?

Just another PLAN!

2

3

WHY BUSINESS PLANNING

NO! It's not and we will answer the questions

- Why business planning?
- What does it involve?
- How should the process be structured?

How does a water utility fit in this process?

- What does it mean for WASAs or NSUSC AS A special case?

Why Business Planning

"Can a ship sail without a map and a rudder?"

Without Business Planning an organisation will fail to move towards the intended direction

But…

Water supply utilities are not ordinary businesses
Operate on a highly political level
Provide goods and services that are essential for health and poverty reduction

Why Business Planning

But again…water utilities

Have customers
Spend money to provide service
Earn money from customers
Invest to improve services
Manage people
Operate with many demands and "never" enough resources

Almost just like any other company

Why Business Planning

Therefore, Business Planning is an essential tool

- to help WASAs & NSUSC to plan operations, investments and finance
- to provide means to share information to stakeholders to reach agreement with WASAs & NSUSC's plans
- to makes sure, investment decisions take account of what consumers want
- to help to plan for "full O&M cost recovery" and operational financial sustainability

What is Business Planning

Three questions

- Who are we and what is our purpose?

OUR MISSION

- Where do we need and want to be?

OUR VISION

- How do we get there?

OUR STRATEGY

What is Strategic Business Planning

8

NOW LET US REFLECT ON NSUSC
A CASE STUDY

Goal-driven Business Planning

9

NSUSC's VISION

- To be a leader in sustainable water supply, sewerage and solid waste management, delivery of quality customer services

VALID?

NSUSC's MISSION

- To deliver sustainable water supply, sewerage and solid waste services in a safe, efficient and effective manner

AGREED?

NSUSC's VALUES

- Honesty and Integrity
- Health and Safety
- Innovation
- Teamwork and Professionalism
- Staff Well-Being and Life Balance

CONFIRMED?

Goal-driven Business Planning

10

NSUSC's GOALS

- Purpose and objectives in line with various agreements between the GoS, TMAs and ADB

Improved Level of Services
Cost efficiency

NSUSC's STRATEGY

- The HOWS to achieve the goals

Operational
Performance Monitoring
Customer Service
Organisation
Tariff
Finance
Compliance
Human Resources

IMPLEMEN TATION

- NSUSC's operating plans to to carry out strategies

WASA Lahore

Vision

WASA Lahore to be quality service providing utility, exceeding consumers' expectations through dedicated employees committed to excellence

Mission

WASA Lahore would contribute towards making Lahore city cleaner and environment friendly.

Offering quality consumer services in the field of Water Supply and Sewerage.

Ensuring cost effective measures in Development works and operation & maintenance.

Adhering to professional ethics and zero tolerance for corruption.

Revenue generation at least sufficient to meet with the non development expenditure and to make the system self sustainable.

Mission Statement

WASA L

To make our customers feel welcome, appreciated, and worthy of our best efforts in everything we do for providing water supply, sewerage and drainage services.

WASA G : Provision, operation and maintenance of water supply, sewerage/drainage facilities in the urban area of Gujranwala.

WASA F :To make our customers feel welcome, appreciated, and worthy of our best efforts in everything we do for providing water supply, sewerage and drainage services.

WASA M :To make our customers feel welcome, appreciated, and worthy of our best efforts in everything we do for providing water supply, sewerage and drainage services.

NSUSC : To deliver sustainable water supply, sewerage and solid waste services in a safe, efficient and effective manner

11

What is a Business Plan

A SUMMARY

1. **Practical tool** for managing the future of Utilities
2. **Marketing tool** towards stakeholders
3. Brings together **costs of Utilities plans** to improve and extend the services with **income to pay for them**
4. a **participatory** and **continuous** process
5. a **combination** of narrative description & financial projections
6. integrates the Business Planning Process into the management

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Obligation

WASAs & NSUSC's Business Plan doesn't have to be LONG or COMPLICATED but:

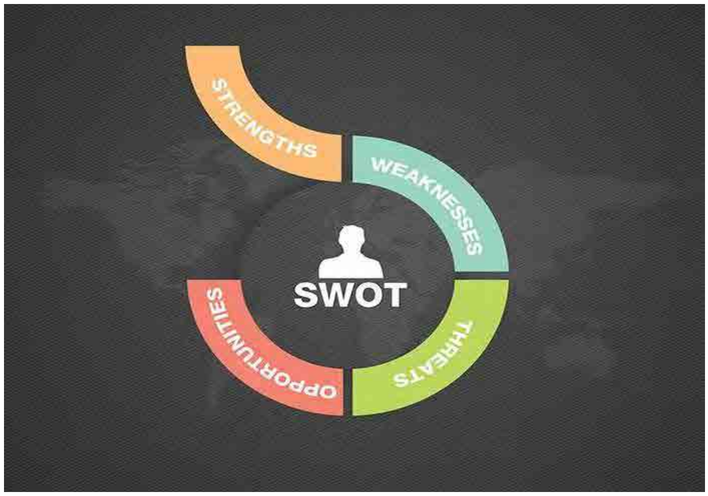
- **Must contain the information that justifies the decisions made about future investments**
- **Must address the legal & contractual obligations of WASA & NSUSC as per LDA Act , DLCA and SAMAs**
- **Notification of IDAMP by P&D Govt of Punjab**

Exercise Visioning and Mission Exercise

Develop Vision for WASAs in Group

Develop New Mission for WASAs in Group

Activity



SWOT stands for: Strength, Weakness, Opportunity, Threat. A SWOT analysis guides you to identify your organization's strengths and weaknesses (S-W), as well as broader opportunities and threats (O-T). Developing a fuller awareness of the situation helps with both strategic planning and decision-making.

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SWOT ANALYSIS- Activity

GROUP ACTIVITY

GAP Analysis through SWOT technique for IDAMPs of FIVE WASAs

16

SWOT Matrix

Strengths – something that you are doing right or are good at. It may be a skill, a competence or a competitive advantage that you have over rivals. Questions to ask: ■ What are your advantages? ■ What do you do well?	**Weaknesses** – something that you lack or do poorly when compared with rivals. A condition that puts you at a disadvantage. Questions to ask: ■ What could be improved? ■ What is done badly? ■ What should be avoided?
Opportunities – a realistic avenue for future growth in the business. Something to be used to develop a competitive advantage. Questions to ask: ■ What are the market trends? ■ [illegible]	**Threats** – a factor that you may or may not have control over that could lead to a decline in business. Questions to ask: ■ What obstacles do you face? ■ What is your competition doing?

SWOT at Organizational Levelhttps://www.youtube.com/watch?v=GNXYI10Po6A

17

Strengths	Weakness
Opportunities	Threat

18

Conducting a SWOT analysis

Conducing a SWOT analysis is the construction of a non-financial balance sheet. Existing or potential assets are in the left columns representing the strengths and opportunities, and existing or potential liabilities are in the right columns representing the weaknesses and threats The analysis is undertaken using a grid to consider how you will match the strengths to the opportunities and how you will overcome the

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Brainstorming guidelines

We will focus on strengths and weaknesses as the opportunities and threats are less important to WASA & NSUSC because your business objectives are contractually defined and you do not face significant competition

1. What are the strengths of WASAs & NSUSC that we should build on to outperform our contractual obligations?
2. What are the weaknesses of WASAs & NSUSC that we should resolve so we can outperform our contractual obligations?

Brain-storming rules:

- 15 minutes maximum for strengths and 15 minutes maximum for weaknesses
- No right or wrong answers

20

Groups Formation in Each WASAs /NSUSC

1. Water Supply
2. Sewerage
3. Finance
4. Capacity Building
5. Communication

Day 2 :
Session 1

Gap Analysis and Target Setting

Strategies

- Asset Condition Improvement/ Replacement Plan
- Reduction in Energy Billing
- Implementation of Energy Management Opportunities
- Improvement in Pumping Efficiency
- Storage Capacity/ OHR
- Non Revenue Water Reduction (Leakages and Un-Billed Water)
- Project Identification/Project Evaluation (IDAMP) and Costing

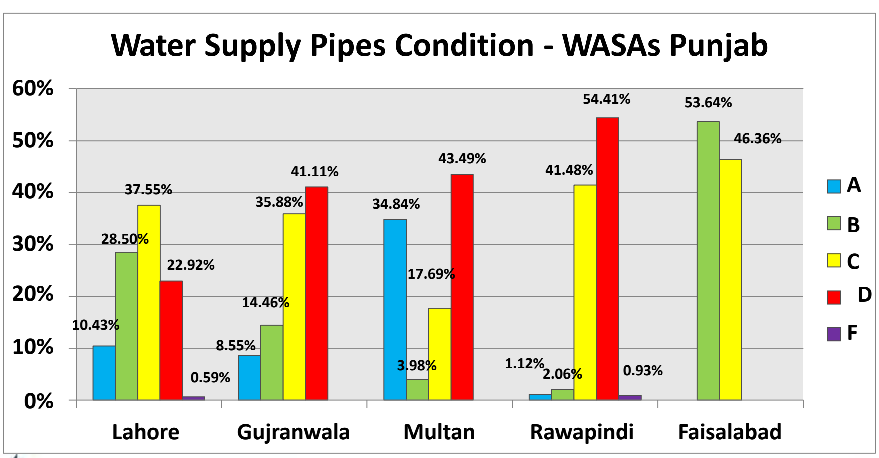
23

Baseline

Water and Sewerage - WASAs

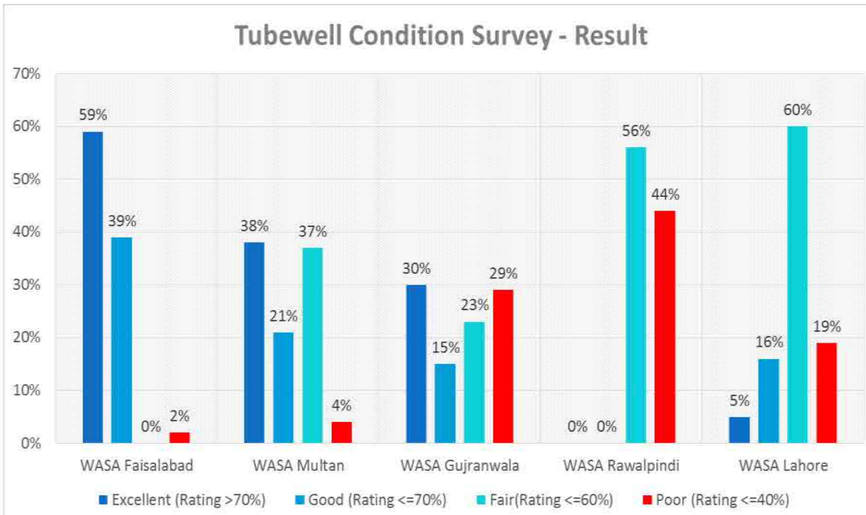
24

Baseline – Water Supply System



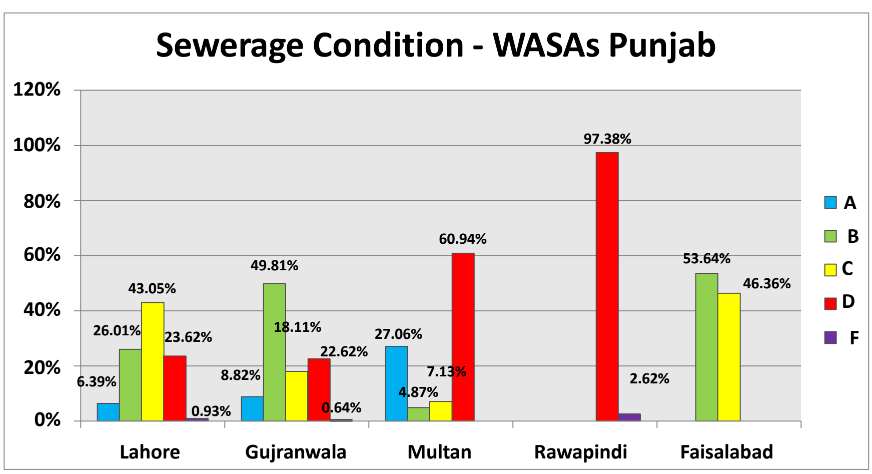
25

Tube well Condition



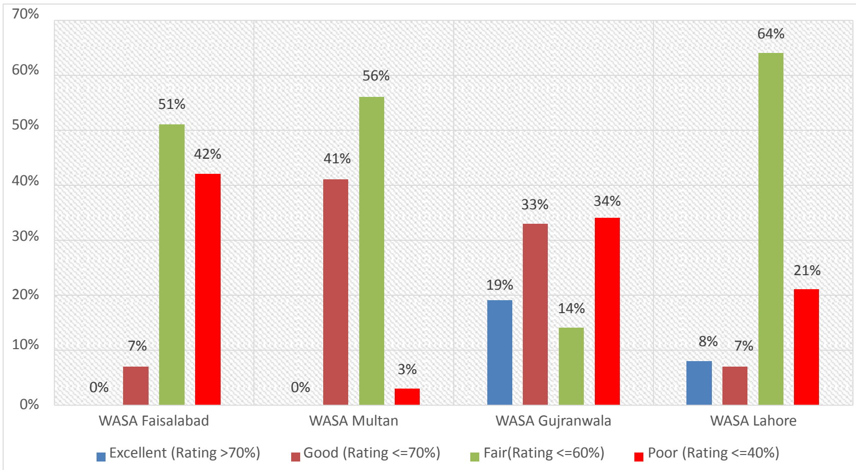
26

Baseline – Sewerage System



27

Disposal Condition



28

Identifying Gaps

Water and Sewerage - WASAs

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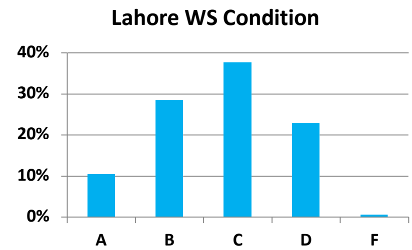
WASA Lahore

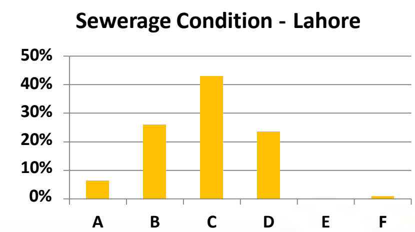
Water Supply Lines

Condition	Length (m)	% Age
A	468158	10.43%
B	1278895	28.50%
C	1685124	37.55%
D	1028403	22.92%
F	26696	0.59%
Total	4487276	100%



Sewerage Lines

Condition	Length (m)	%age Length (m)
A	253909	6.39%
B	1033531	26.01%
C	1710620	43.05%
D	937348	23.59%
F	36783	0.95%
Total	3973136	100.00%

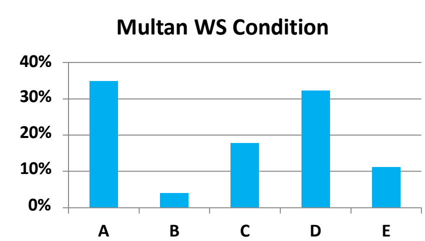


30

WASA Multan

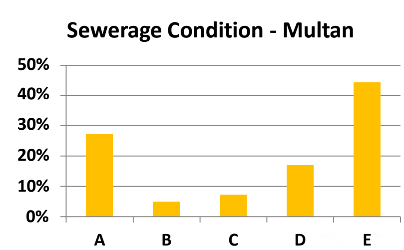
Water Supply Lines

Condition	Length m	%age of Length
A	72119	34.84%
B	8244	3.98%
C	36618	17.69%
D	66819	32.28%
F	23200	11.21%
Total	207000	100.00%



Sewerage Lines

Condition	Length m	%age of Length
A	79403	27.06%
B	14305	4.87%
C	20931	7.13%
D	49351	16.82%
F	129490	44.12%
Total	293480	100.00%

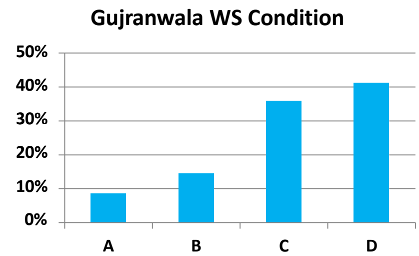


31

WASA Gujranwala

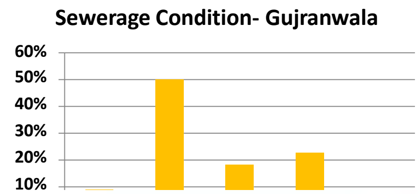
Water Supply Lines

Condition	Length (m)	% age of Length
A	71974	8.82%
B	406284	49.81%
C	147677	18.11%
D	184466	22.62%
F	5241	0.64%
Total	815641	100.00%



Sewerage Lines

Condition	Length m	%age of length
A	43316	8.55%
B	73248	14.46%
C	181777	35.88%

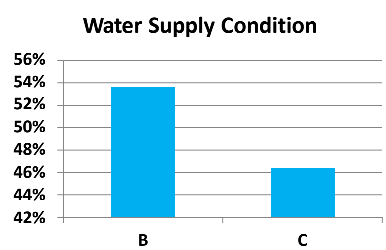


32

WASA Faisalabad

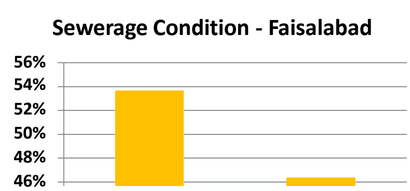
Water Supply Lines

Condition	Length m	%age of Length
B	14017	90.44%
C	1481	9.56%
Total	15498	100.00%



Sewerage Lines

Condition	Length m	%age of Length
B	943854	53.64%
C	815594	46.36%

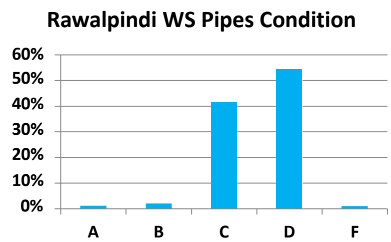


33

WASA Rawalpindi

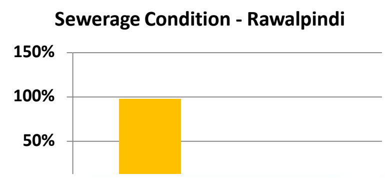
Water Supply Lines

Condition	Length m	%age of Length
A	8065	1.12%
B	14752	2.06%
C	297470	41.48%
D	390222	54.41%
F	6678	0.93%
Total	717187	100.00%



Sewerage Lines

Condition	Length	%age of Length
D	130796	97.38%
F	3526	2.62%



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Exercise of Identifying Gaps by using MS Excel

35

Exercise of identifying gaps using MS Excel

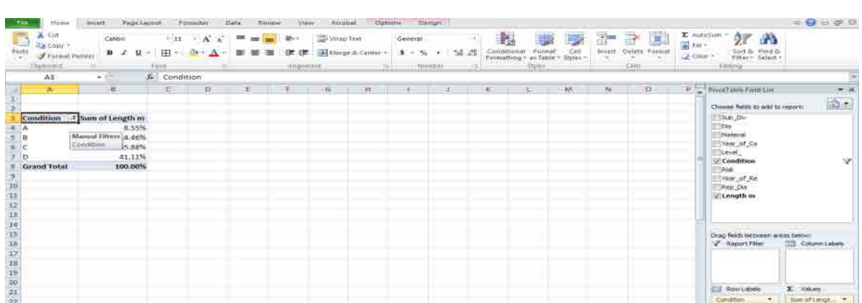
Excel Data of Water Supply & Sewerage Pipes

Sub_Div	Dia	Material	Year_of_Co	Level_	Condition	Risk	Year_of_Re	Rep_Dia	Length m
Zone3-B	4"	AC	1982	T	C	M	1	6"	0.106936
Zone1-Northern	4"	AC	1982	P	C	M	1	6"	10.26912
Zone3-A	6"	AC	1982	P	C	M	1	8"	276.7541
Zone3-A	3"	AC	1982	S	C	M	1	4"	175.483
Zone1-Southern	4"	AC	1980	S	D	M	1	6"	121.3562
Zone1-Southern	4"	AC	1980	S	D	M	1	6"	93.08071
Zone1-Southern	4"	AC	1980	S	D	M	1	6"	17.38018
Zone1-Southern	6"	AC	1980	S	D	M	1	8"	253.9245
Zone1-Southern	4"	AC	1980	S	D	M	1	6"	13.77523
Zone3-B	4"	PVC	2008	P	B	M	12	6"	244.1071
Zone3-B	4"	AC	1980	T	D	M	1	6"	145.1322
Zone3-B	4"	AC	1980	T	D	M	1	6"	32.19875
Zone3-B	4"	AC	1980	T	D	M	1	6"	108.7276
Zone3-B	4"	AC	1980	T	D	M	1	6"	103.22
Zone3-B	4"	AC	1980	T	D	M	1	6"	58.31624

36

Using Excel tools for Analysis

1. Open Excel data given
2. Select the data
3. Go to Insert table and Click on Pivot Table
4. Drag and Drop the Condition field to Row Labels & Length Field to Values



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SETTING TARGETS

38

Selection of Targets and Indictors to Improve

Add indictors notified under IDAMP
Discuss which are five or 7 key indicators to select based on previous slides

Group Activity A

Indicator	Baseline	Proposed Targets	Year 1	Year 2	Year 3
% Water Coverage					
%Sewerage Coverage			C		
Water production					
Water consumption					
Unaccounted for water					
Non-revenue water					
Proportion of functional meters					
Metered water supply	p				
Sewerage blockages					
Pipe leakages					
Unit operational cost - water sold (production cost at consumer end)					
Unit operational cost - water produced (gross production cost)					
Biologically Unfit Water Samples at Tap					
Water Quality - Samples having residual chlorine					
Water Supply Complaints					
Sewerage Complaints					

Targets Setting

Sector or Indictor	Existing Gap /Baseline	Targets	Service Delivery Target
Water Supply			
Sewerage			
TWs			

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Activity B: Setting Targets
To improve asset condition

	Gap	Baseline (C,D,F Condition)		Targets		
WASA	Indicators	%age of Length	Length (m)	Year 1	Year 2	Year 3
	Water Supply Lines					
	Sewerage Lines					

42

Day 3 :
Performance Improvement Plan

43

Service Improvement by Replacement & Extension of Water Supply Network

Steps:

1. Marking of lines to be replaced on GIS base map
2. Marking of New lines on GIS base map for improving % of water supply coverage
3. Tube well Rehabilitation
4. Operationalization of OHRs
5. Making Project in phased manners
6. Costing of Projects based on pipe length

44

Costing

Project Cost

Water Supply Pipe replacement or New Installation

Diameter	Length	Unit Cost (Per meter)	Pipe Cost (A)	Construction Cost (B)	Total Cost (A+B)
3"					
4"					
6"					

Day 4 :
Performance Improvement Plan

Service Improvement by Replacement & Extension of Sewerage Network

Steps:

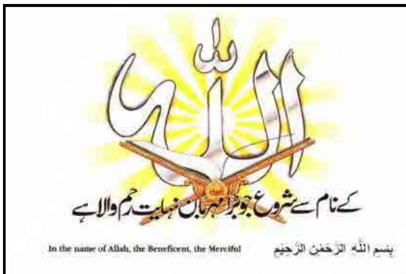
1. Marking of lines to be replaced on GIS base map
2. Marking of New lines on GIS base map for improving % of Sewerage coverage
3. Disposal station - repair/replacement
4. Making Project in phased manners
5. Costing of Projects based on pipe length

Costing

Project Cost

Sewerage replacement or New Installation

Diameter	Length	Unit Cost (Per meter)	Pipe Cost (A)	Construction Cost (B)	Total Cost (A+B)
6"					
9"					
12"					



1

Business Planning & GAP Analysis

Gap Analysis and Target Setting

For Under ground Assets - WASAs

Abid Hussainy
Senior Specialist

ALJAZARI ACADEMY

Review of Yesterday Work

- WASA and NSUSC and MC Sargodha
- We have
- Learn about Bench Marking and KPI
- a new vision and
- Mission drafted
- We have reviewed and Map our asset management and monitoring system and KPI system
- We have done SWOT analysis of our organization
- Internal and External

Today Objectives

- Learn about KPI
- Agree on the KPI
- Set Target for the KPI
- Set Base Line of KPI
- Carry out Gap analysis for water supply , sewerage and drainage

Business Plan Report -

1. Introduction to Business Plan and its objectives
2. Brief about your organization , its mandate and legal framework and contractual obligation, assets, staff and area of operation
3. Vision and mission
4. SWOT
5. Gap analysis
6. KPI
7. Targets

2

OBJECTIVES

- ✓ IDENTIFY GAPS in ASSETS
- ✓ Gaps Analysis
- ✓ Target Setting FOR KPI
- ✓ Formulation of Strategy

Discuss the KPI

- The KPIs are representative of a broad range of activities that we undertake; covering reliability of supply, customer experience, the environment, water quality and financial performance.
- What are the process of KPI reporting and which KPI are important
  - SELECT KPI for your organization – Group Work

Discuss Case Study of South Water UK

KPI OF BUSINESS PLANNING

1

What to Increase?

1. Connected Customers
2. Pumping Efficiency & Asset Condition
3. Billing Collection
4. Bill Delivery
5. Water Quality
6. 24/7 Water Supply
7. Planning

What to decease?

1. Expenses (Energy and O&M) / Production Cost
2. Non Revenue Water
3. Complaint Re-addressal Time

3

Baseline

Water and Sewerage
- WASAs

Asset management course -

PIPE HAS CONDITION

15

➢Asset Condition

Asset condition explains its state in term of defined ranking. For example

A =	Excellent: No noticeable defects. Some aging or wear may be visible.
B =	Good: Only minor deterioration or defects are evident.
C =	Fair: Some deterioration or defects are evident, but function is not significantly affected.
D =	Poor: Serious deterioration in at least some portion of the structure. Function is inadequate.
F =	Failed: No longer functional. General failure or complete failure of a major structural component.

1

CONDITIONAL SURVEY PARAMETERS FOR TUBEWELLS

Physical Condition of Pump	Lubricant Leakage	Water Leakage	Cable Insulation	Cable Sizing	Transformer Condition	Energy Meter Condition
Performance of Starter	Pump Vibration	Pump Noise	Motor Temperature Control	Cooling Fan Condition	Piping Condition	Condition of Return Valve
Pressure Gauge Condition	Ventilation	Civil Structure	Generator Condition	Power Factor Improvement Capacitor	Safety Equipment	Chlorinator Condition
Log Book	Earthing Condition	Screening Chamber Condition	Lighting Condition	Human Signaling Signs	SoPs	

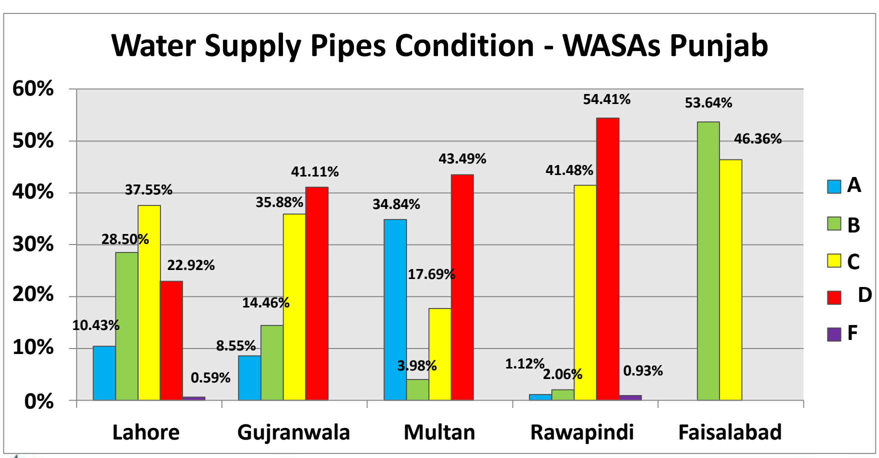
CONDITIONAL PARAMETERS FOR WATER SUPPLY LINES/SEWER LINES

1

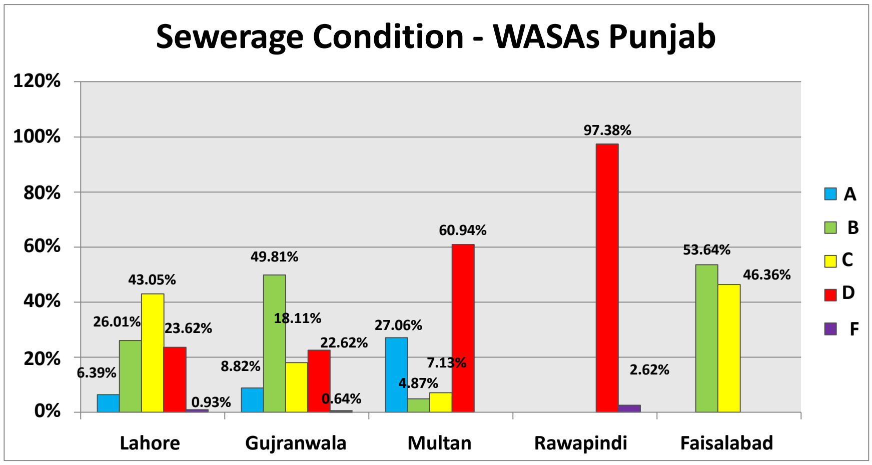
- Material
- Age
- Physical Condition (A-F)
- Pipe Size
- Complaints

Water Supply System

4



Sewerage System



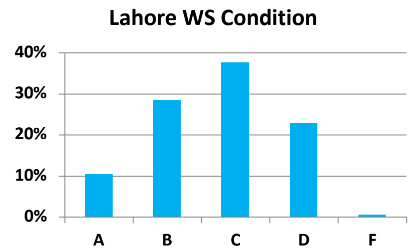
Gaps Identification

Water and Sewerage
- WASAs

WASA Lahore

Water Supply Lines

Condition	Length (m)	% age
A	468158	10.43%
B	1278895	28.50%
C	1685124	37.55%
D	1028403	22.92%
F	26696	0.59%
Total	4487276	100%



Sewerage Lines

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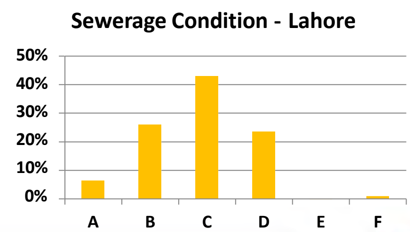
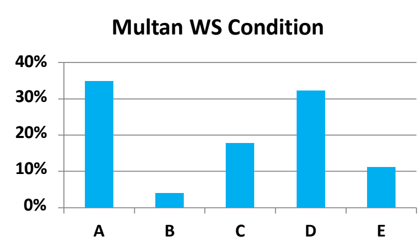
B	1033531	26.01%
C	1710620	43.05%
D	937348	23.59%
F	36783	0.95%
Total	3973136	100.00%



WASA Multan

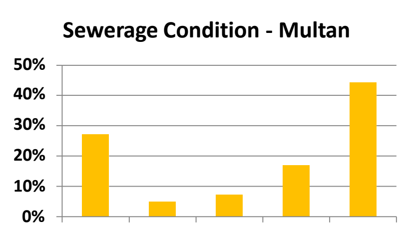
Water Supply Lines

Condition	Length m	%age of Length
A	72119	34.84%
B	8244	3.98%
C	36618	17.69%
D	66819	32.28%
F	23200	11.21%
Total	207000	100.00%



Sewerage Lines

Condition	Length m	%age of Length
A	79403	27.06%
B	14305	4.87%
C	20931	7.13%
D	49351	16.82%
F	129490	44.12%
Total	293480	100.00%

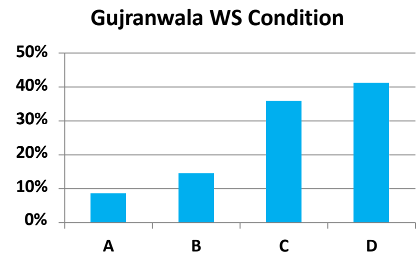


WASA Gujranwala

9

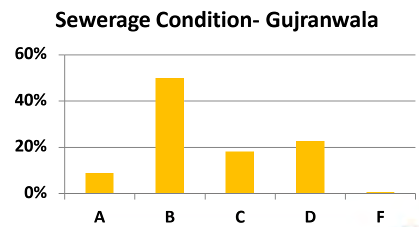
Water Supply Lines

Condition	Length (m)	% age of Length
A	71974	8.82%
B	406284	49.81%
C	147677	18.11%
D	184466	22.62%
F	5241	0.64%
Total	815641	100.00%



Sewerage Lines

Condition	Length m	%age of length
A	43316	8.55%
B	73248	14.46%
C	181777	35.88%
D	208281	41.11%
Grand Total	506623	100.00%

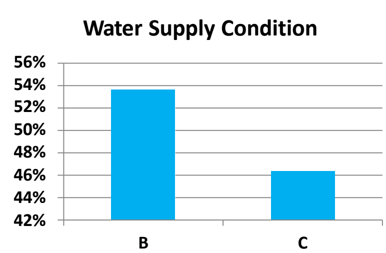


WASA Faisalabad

10

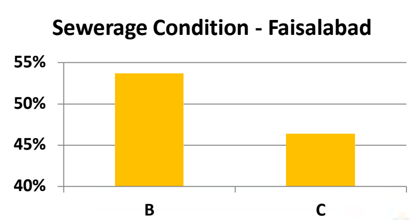
Water Supply Lines

Condition	Length m	%age of Length
B	14017	90.44%
C	1481	9.56%
Total	15498	100.00%



Sewerage Lines

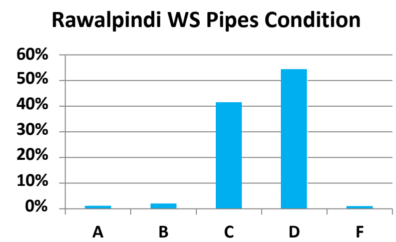
Condition	Length m	%age of Length
B	943854	53.64%
C	815594	46.36%



WASA Rawalpindi

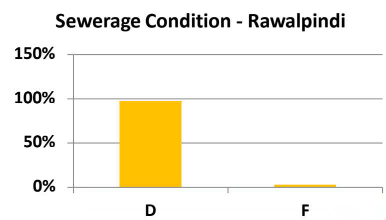
Water Supply Lines

Condition	Length m	%age of Length
A	8065	1.12%
B	14752	2.06%
C	297470	41.48%
D	390222	54.41%
F	6678	0.93%
Total	717187	100.00%



Sewerage Lines

Condition	Length	%age of Length
D	130796	97.38%
F	3526	2.62%



Exercise of Identifying Gaps by using MS Excel

13

Exercise of identifying gaps using MS Excel

Excel Data of Water Supply & Sewerage Pipes

Sub_Div	Dia	Material	Year_of_Co	Level_	Condition	Risk	Year_of_Re	Rep_Dia	Length m
Zone3-B	4"	AC	1982	T	C	M	1	6"	0.106936
Zone1-Northern	4"	AC	1982	P	C	M	1	6"	10.26912
Zone3-A	6"	AC	1982	P	C	M	1	8"	276.7541
Zone3-A	3"	AC	1982	S	C	M	1	4"	175.483
Zone1-Southern	4"	AC	1980	S	D	M	1	6"	121.3562
Zone1-Southern	4"	AC	1980	S	D	M	1	6"	93.08071
Zone1-Southern	4"	AC	1980	S	D	M	1	6"	17.38018
Zone1-Southern	6"	AC	1980	S	D	M	1	8"	253.9245
Zone1-Southern	4"	AC	1980	S	D	M	1	6"	13.77523
Zone3-B	4"	PVC	2008	P	B	M	12	6"	244.1071
Zone3-B	4"	AC	1980	T	D	M	1	6"	145.1322
Zone3-B	4"	AC	1980	T	D	M	1	6"	32.19875
Zone3-B	4"	AC	1980	T	D	M	1	6"	108.7276
Zone3-B	4"	AC	1980	T	D	M	1	6"	103.22
Zone3-B	4"	AC	1980	T	D	M	1	6"	58.31624

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Asset attribute/information

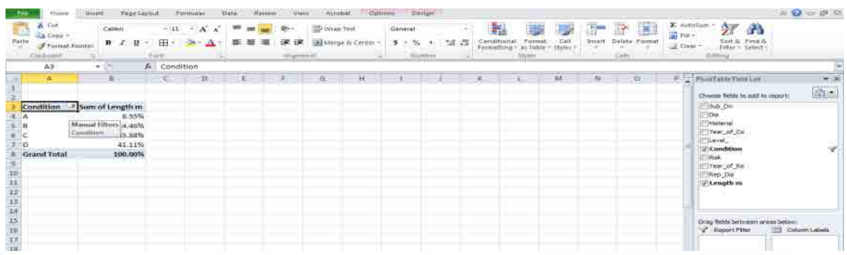
Asset parameters include :

1	Diameter (inch)
2	Material (pipe material)
3	Year of Installation
4	Level (P,S T)
5	Condition (A,B,C,D,F)
6	Risk (H,M L)
7	Replacement Year
8	Replacement dia
9	Town Name
10	Subdivision/Zone Name

16

Using Excel tools for Analysis

1. **Open Excel data given**
2. **Select the data**
3. **Go to Insert table and Click on Pivot Table**
4. **Drag and Drop the Condition field to Row Labels & Length Field to Values**



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TARGETS SETTING

18

Setting Targets to improve asset condition

WASA	Baseline			Targets		
	C	D	F	Year 1	Year 2	Year 3
	Length (m)	Length (m)	Length (m)	C (m)	D (m)	F (m)
Lahore						
Gujranwala						
Multan						
Rawalpindi						
Faisalabad						

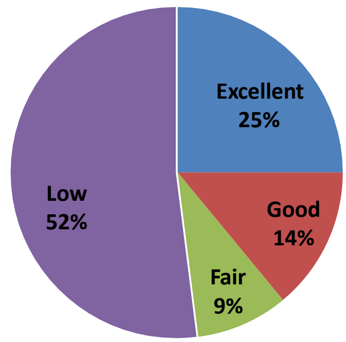
Tube wells and Disposals

Gaps Analysis and target Setting

GAP 1: LOW AND FAIR PUMPING EFFICIENCY

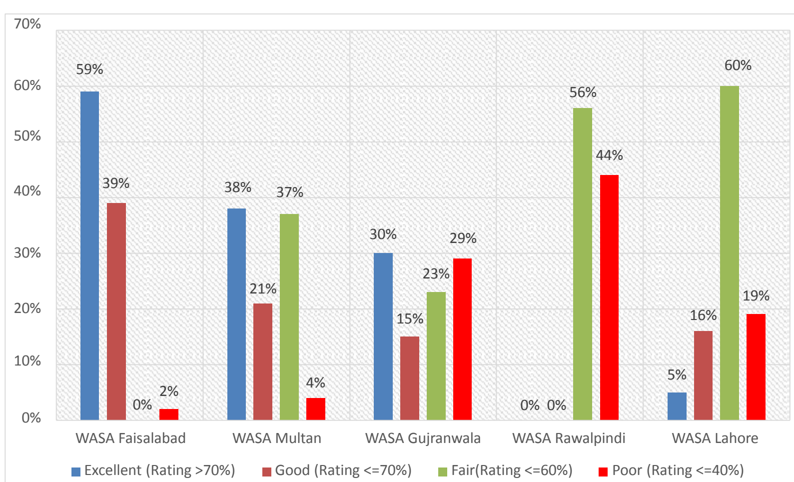
1

#	City	LOW	FAIR	GOOD	EXCELLENT
1	Lahore	278	75	91	207
2	Multan	79	17	11	18
3	Rawalpindi	323	19	12	22
4	Gujranwala	37	9	19	22
5	Faisalabad	29	12	67	89
	Total	746	132	200	358



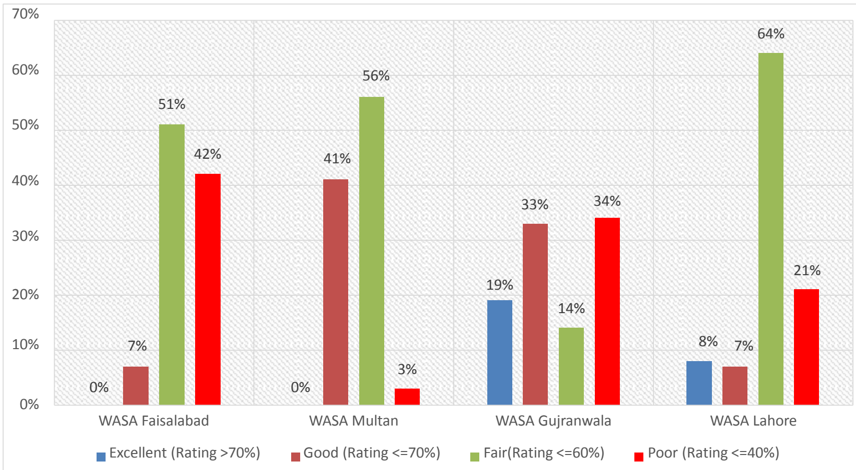
GAP 2: TUBE WELL CONDITION

1



1

GAP 3: DISPOSAL CONDITION



1

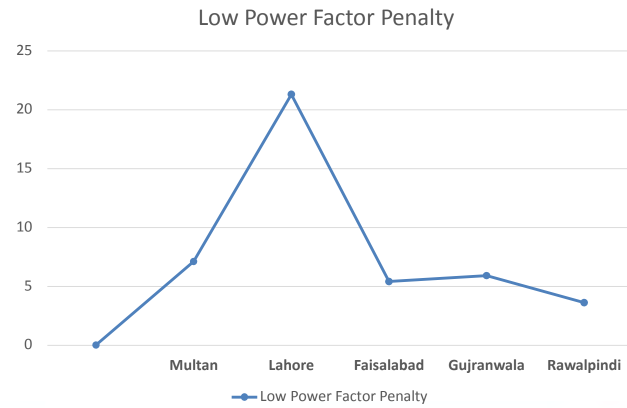
GROUPACTIVITY 1: TARGET SETTING TO IMPROVE ASSET CONDITION

WASA	GAPS	Base Line		Target Year 1		Target Year 2		Target Year 3	
		Poor D	Fair C	Poor D	Fair C	Poor D	Fair C	Poor D	Fair C
LHR/ GUJ/ MUL/ FSD/ RWP/ NSUSC	Pumping Efficiency								
	Tube well Condition								
	Disposal Condition								
	OHR Condition								

GAP 4 : POWER FACTOR PENALTY

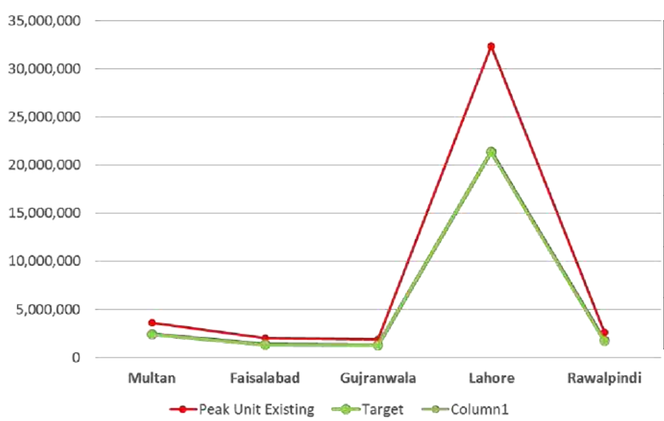
1

WASAs	Low Power Factor Penalty (PKR-In Million)
Multan	7.1
Lahore	21.3
Faisalabad	5.4
Gujranwala	5.9
Rawalpindi	3.6



GAP 5 : PEAK UNITS CONSUMPTION

1



WASA	Peak (KWH) Units
Multan	3,601,578
Faisalabad	2,037,707
Gujranwala	1,901,992
Lahore	32,343,009
Rawalpindi	2,634,730

GAP NO.6 NON REVENUE WATER

1

Name	Water Connections	Water Production (M cum)	% NRW	Water Loss (M Cum)
KW&SB	1.04 M	1,178	35	413
L-WASA	631,000	680	40	272
F-WASA	110,000	51	45	23
G-WASA	35,980	92	40	37
R-WASA	96,780	91	30	37
M-WASA	49,980	36	22	8
WSSP	83,650	-		
CDA	80,480	110	35	39
NSUSC	30,000	30.99	40	12
Total	**2.15 M**	**2,268**	**37.5%**	**841**

The challenge

1

Fix the institutions that should fix the pipes

GROUP ACTIVITY 2 : TASK TARGET SETTING

1

WASA	GAPS	Base Line	Target Year 1	Target Year 2	Target Year 3
Lahore/ Gujranwala/ Multan/ Faisalabad/ Rawalpindi/ NSUSC	Pumping Efficiency (Low + Fair Pumps)				
	Peak Unit Consumption (PKR M)				
	MDI Unit Consumption (PKR M)				
	Power Factor Penalty (PKR M)				

GROUP ACTIVITY 3: COSTING FOR IMPLEMENTATION

1

WASA	Tasks	Cost Year 1	Cost Year 2	Cost Year 3	Total Cost
Lahore/ Gujranwala/ Multan/ Faisalabad/ Rawalpindi/ NSUSC	Pumping Efficiency (Low + Fair Pumps)				
	Peak Unit Consumption (PKR M)				
	MDI Unit Consumption (PKR M)				
	Power Factor Penalty (PKR M)				

1

CHARACTERISTICS OF WELL-PERFORMING UTILITIES

- Accountability towards its stakeholders
- Autonomy to develop sustainable business principles
- Customer focus to ensure a good service delivery
- Market orientation to use the best practices (efficiency).

1

TARGET /PHASING

Gaps	Total	Year 1	Year 2	Year 3
Power Factor	43.3	15	20	8.3
Peak Unit Consumption	42.5	15	20	7.5
MDI Consumption 0.4 (x10000)	24.6	0.10	0.10	
Pumping Efficiency	878	220	358	300

1

STRATEGIES

- Asset Condition Improvement/ Replacement Plan
- Reduction in Energy Billing
- Implementation of Energy Management Opportunities
- Improvement in Pumping Efficiency
- Storage Capacity/ OHR
- Reduction of Non Revenue Water (Leakages and Un-Billed Water)
- Project Identification/Project Evaluation (IDAMP) and Costing

1

Thank You!

1

EFFICIENCY ENHANCEMENT

Revenue Saved Per Pump (Rs.) = Unit Price (per KWH) * Load (%) * (1/old Efficiency – 1/New Efficiency)

Avg. Revenue Saved Per WASA = (No. of Tube wells) * Unit Price (per KWH) * Load (%) * (1/avg. old Efficiency – 1/Avg. New Efficiency)

1

CONDITIONAL SURVEY PARAMETERS FOR TUBEWELLS

Physical Condition of Pump	Lubricant Leakage	Water Leakage	Cable Insulation	Cable Sizing	Transformer Condition	Energy Meter Condition
Performance of Starter	Pump Vibration	Pump Noise	Motor Temperature Control	Cooling Fan Condition	Piping Condition	Condition of Return Valve
Pressure Gauge Condition	Ventilation	Civil Structure	Generator Condition	Power Factor Improvement Capacitor	Safety Equipment	Chlorinator Condition
Log Book	Earthing Condition	Screening Chamber Condition	Lighting Condition	Human Signaling Signs	SoPs	

CONDITIONAL PARAMETERS FOR WATER SUPPLY LINES/SEWER LINES

1

- Material
- Age
- Physical Condition (A-F)
- Pipe Size
- Complaints

EXERCISE

1

No. of Tube wells In WASA = 630 (WL),415 (WR), 88 (WF),66 (WG), 108 (WM)

Load (%) = 85

Unit Price (KWH) = Rs. 15

Avg. Old Efficiency of Pump= 0.42

Avg. New Proposed Efficiency = 0.72

Calculate revenue saved per year if operation time of tube wells is 16 hours a day.

1

Q/A

1

Thank You!

Strategies

- Condition Improvement/ Pipe Replacement Plan
- Project Identification
- Project Prioritization and evaluation
- Project Costing

MODULE - 1

Day-2 Session-3

KPIs of Revenue Management

Muhammad Kashif
Municipal Financial Specialist

BENCHMARKING METHODOLOGY

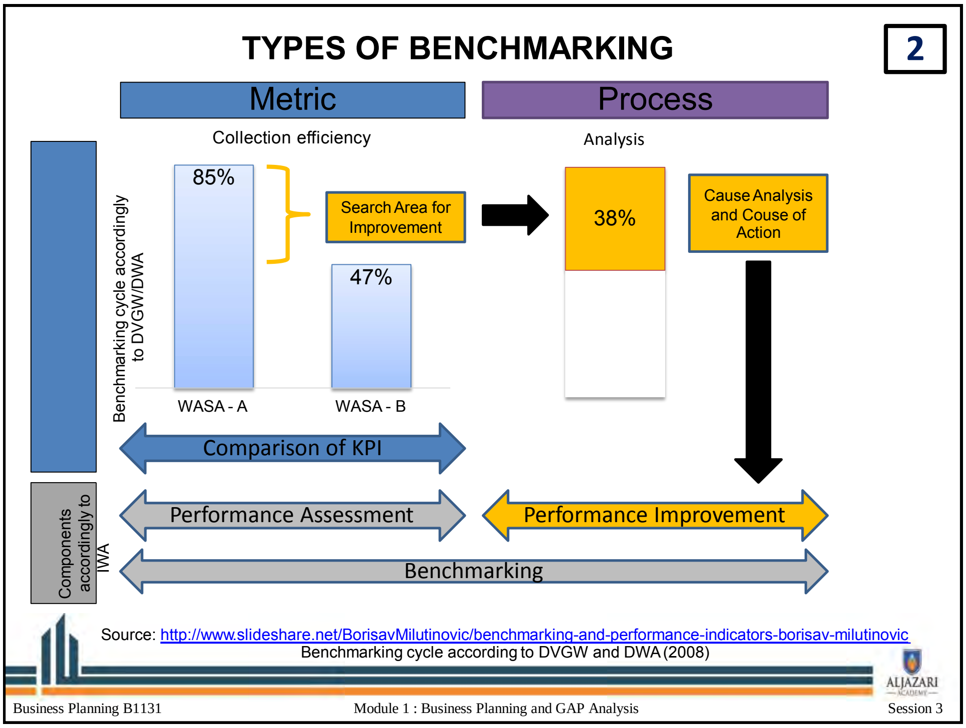
1

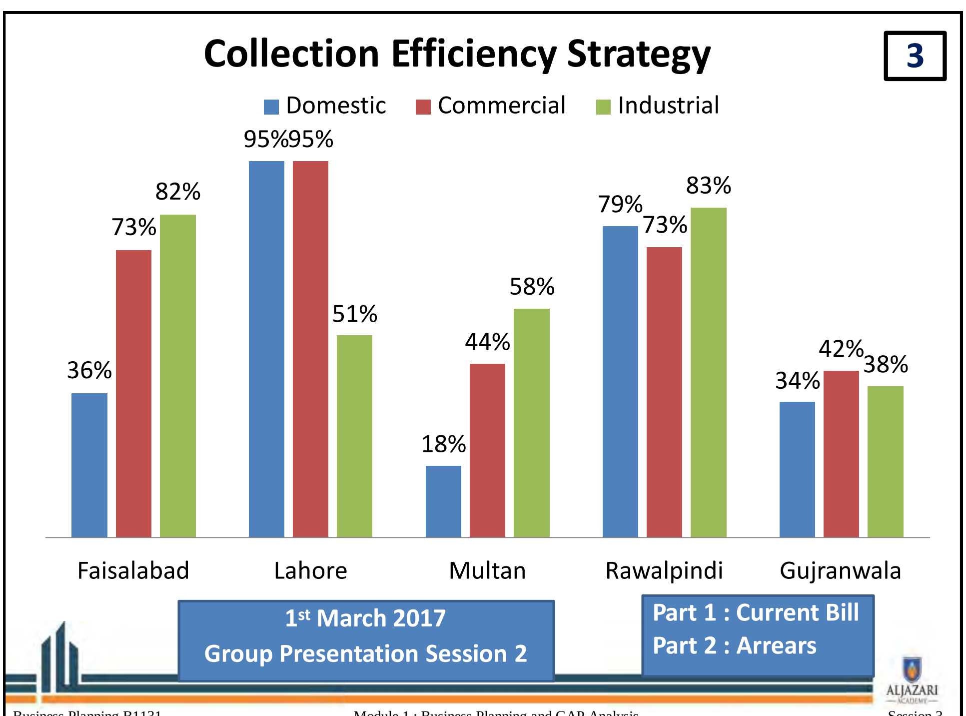
1 2 3 4 5

Select Types

TYPES OF BENCHMARKING

Metric	Process
• Numerical measurement of performance levels • Comparison with other WSS utilities • Identify areas for improvement	• Identify the key processes and learn best practices

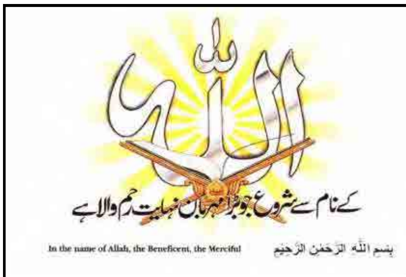

TYPES OF BENCHMARKING
2
Metric
Process
Collection efficiency
Analysis
85%
47%
WASA - A
WASA - B
Search Area for Improvement
38%
Cause Analysis and Couse of Action
Benchmarking cycle accordingly to DVGW/DWA
Comparison of KPI
Components accordingly to IWA
Performance Assessment
Performance Improvement
Benchmarking
Source: http://www.slideshare.net/BorisavMilutinovic/benchmarking-and-performance-indicators-borisav-milutinovic
Benchmarking cycle according to DVGW and DWA (2008)
ALJAZARI
Business Planning B1131
Module 1 : Business Planning and GAP Analysis
Session 3


Collection Efficiency Strategy
3
Domestic
Commercial
Industrial
36%
73%
82%
95%95%
51%
18%
44%
58%
79%
73%
83%
34%
42%
38%
Faisalabad
Lahore
Multan
Rawalpindi
Gujranwala
1st March 2017
Group Presentation Session 2
Part 1 : Current Bill
Part 2 : Arrears
ALJAZARI
Business Planning B1131
Module 1 : Business Planning and GAP Analysis
Session 3

1

MODULE - 1

Business Planning & GAP Analysis



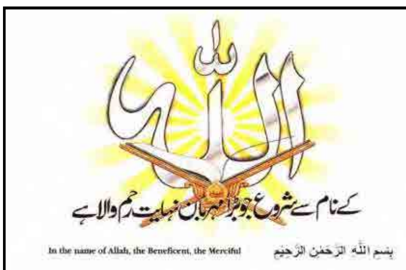
COLLECTION EFFICIENCY & OPERATIONAL DEFICIT (with Simulation Exercises)

Muhammad Samie
Senior Instructor, AJWA

2

MODULE - 1

Business Planning & GAP Analysis



BUDGETARY STRUCTURE ANALYSIS & DEFICIT ASSESSMENT (PART - I)

BUDGETARY STRUCTURE ANALYSIS & DEFICIT ASSESSMENT

3

LEARNING OUTCOMES:

Use of MS EXCEL in:

LO1: Detailed understanding of WASA budget and its components including the concepts of **operational deficit** and **working ratio** and **collection efficiency**

LO2: Computation of **total operational receipts** and **total operational expenses**

LO3: Using **pie charts** to perform **figurative analysis** of sources to finance operational expenses over a period of three years.

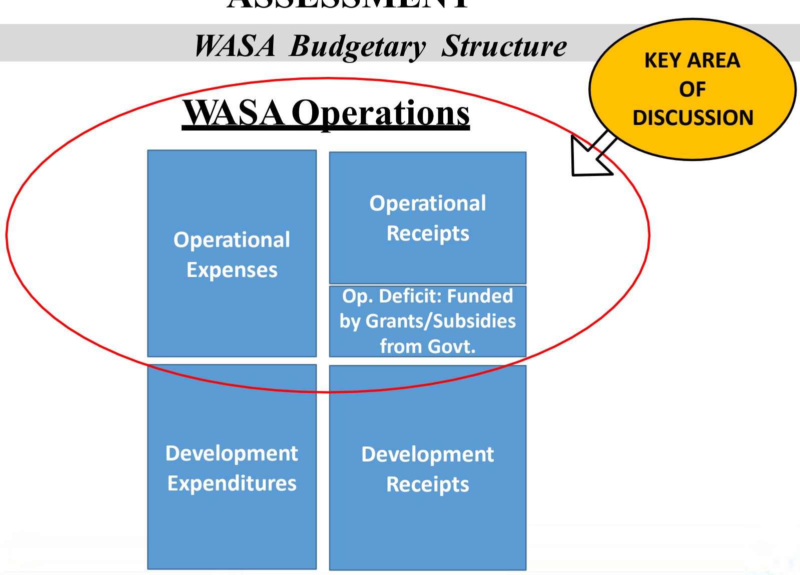
LO4: Simulation exercise of **Collection Efficiency** through **calculations** and **column chart creation**

LO5: **GAP Analysis** and **Target setting** for **collection efficiency (%), operational deficit (%)** and **working ratio**

BUDGETARY STRUCTURE ANALYSIS & DEFICIT ASSESSMENT

4

WASA Budgetary Structure



Business Planning B1131 Module 1 : Business Planning & GAP Analysis Session 3

BUDGETARY STRUCTURE ANALYSIS & DEFICIT ASSESSMENT

5

WASA Budgetary Structure

Dissecting the Operations' Aspect

Receipt Side

Operational Receipts = *[Water & Sewerage Charges] + [Urban Immovable Property Tax (UIPT)] + [Other Receipts]*

BUDGETARY STRUCTURE ANALYSIS & DEFICIT ASSESSMENT

6

WASA Budgetary Structure

Dissecting the Operations' Aspect

Expense Side

Operational Expenses = *[Salary & Payroll] + [Power & Energy] + [O & M] + [Petroleum expenses] + [Other operational expenses]*

BUDGETARY STRUCTURE ANALYSIS & DEFICIT ASSESSMENT

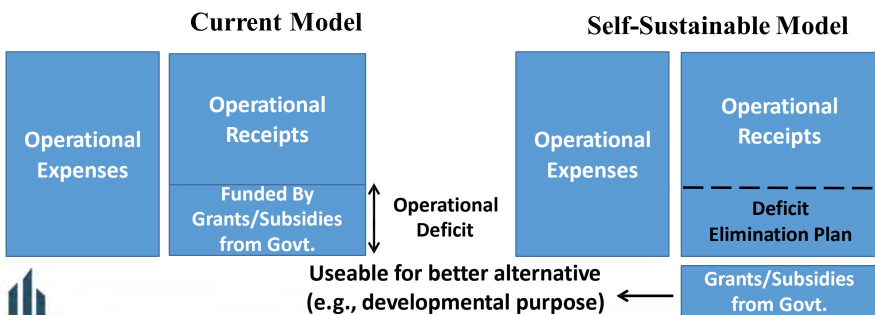
7

What is Operational Deficit (OD) and Working Ratio (WR)?

Operational Deficit (OD) = *[Operational Expenses] - [Operational Receipts]*

VS.

Working Ratio (WR) = *[Operational Expenses] / [Operational Receipts]*

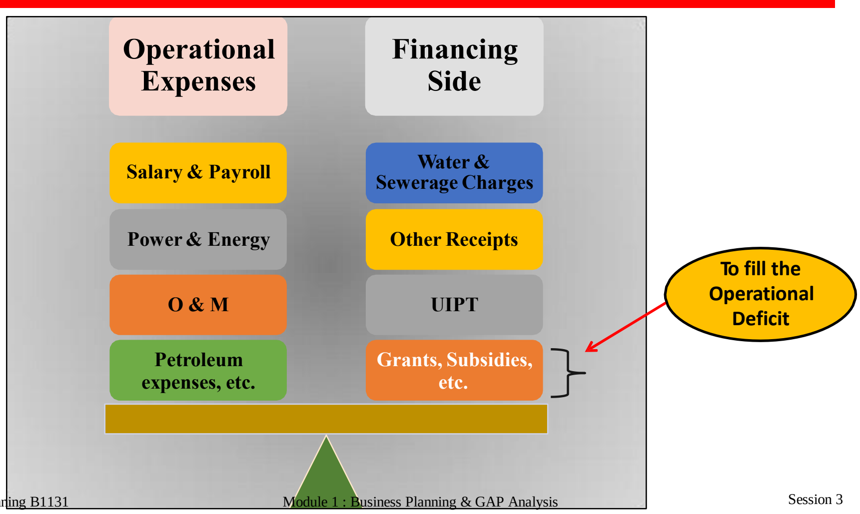


BUDGETARY STRUCTURE ANALYSIS & DEFICIT ASSESSMENT

8

Current Situation Equation

[Total Operational Expenses] = *[Water & Sewerage Charges]* + *[UIPT]* + *[Other Receipts]* + *[Grants, Subsidies, etc.]*

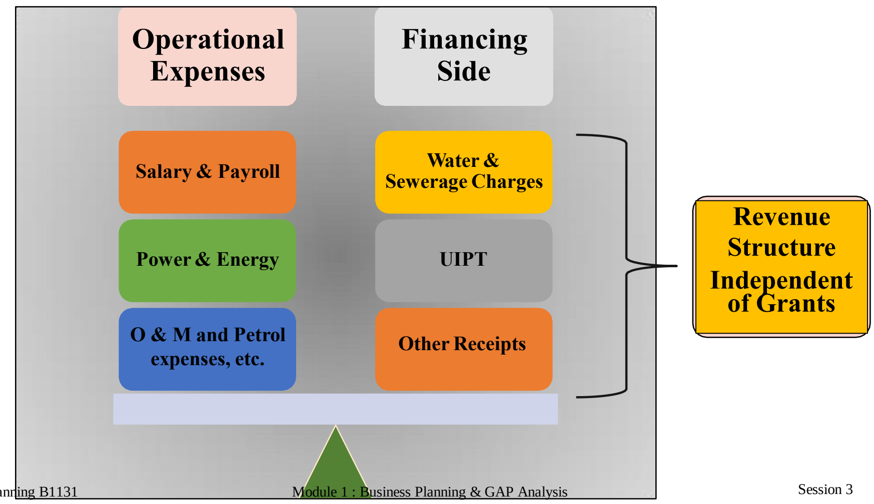


BUDGETARY STRUCTURE ANALYSIS & DEFICIT ASSESSMENT

9

Golden Equation:

[Total Operational Expenses] = *[Water & Sewerage Charges] + [UIPT] + [Other Receipts]*



COLLECTION EFFICIENCY ASSESSMENT

10

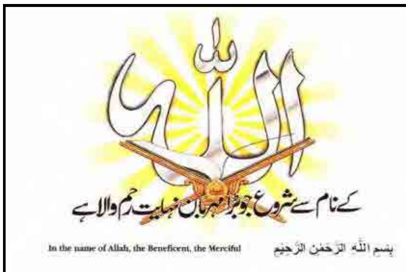
Terminologies

- Bills Issued
- Bills Collected
- Collection Shortfall (Rs./No.)
- Collection Efficiency (%)

Pedagogical Approach *(Simulation Exercise)*

1. **Detail of Bills Issued & Collected** – *Source Data*
2. **Determination of Shortfall (Rs./No.) & Collection Efficiency (%)** - *Calculations*
3. **Creation of graphs for analysis** – *Graphical Analysis*

11



MODULE - 1

Business Planning & GAP Analysis

COLLECTION EFFICIENCY

(SIMULATION EXERCISE)

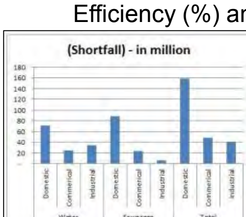
12

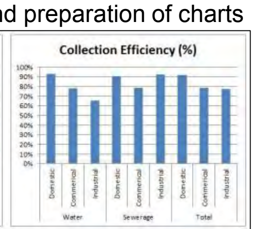
COLLECTION EFFICIENCY ASSESSMENT

LEARNING OUTCOMES

Use of MS EXCEL in calculating the Collection Shortfall (Rs.) and Collection Efficiency (%) and preparation of charts

3. Creation of graphs for analysis





2. Determination of Shortfall & Collection Efficiency

	Water			Sewerage			Total		
	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial
(Shortfall) - in million	71	24	34	88	24	7	159	48	41

	Water			Sewerage			Total		
	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial
Collection Efficiency (%)	93%	78%	65%	90%	79%	92%	92%	78%	77%

1. Detail of Bills Issued & Collected – Source Data

	Water			Sewerage			Total		
	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial
Amount of Bills Issued (Rs. in million)	951	112	98	923	110	82	1,874	222	180
Amount of Bills Collected (Rs. in million)	880	88	64	835	86	75	1,715	174	139

COLLECTION EFFICIENCY ASSESSMENT

13

Step1: Create a new row for calculating Shortfall in Rupees with repeated column headers

Note: **Amount of bills received (Rs.) does not include the receipt of arrears**

1) Copy and paste the column headers of the existing data on two rows below the existing data space.

	Water			Sewerage			Total		
	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial
Amount of Bills Issued (Rs. in million)	951	112	98	923	110	82	1,874	222	180
Amount of Bills Collected (Rs. in million)	880	88	64	835	86	75	1,715	174	139

2) Give the caption of "**Shortfall**" to the cell near the pasted column headers as shown below.

	Water			Sewerage			Total		
	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial
(Shortfall) - in million									

COLLECTION EFFICIENCY ASSESSMENT

14

Step 2: Calculation of Collection Shortfall (Rs.)

Under each consumer category, against the Row label captioned in step 1, calculate the collection shortfall using the formula as shown below.

	A	B	C	D
1				
2				Wate
3			Domestic	Commer
4		Amount of Bills Issued (Rs. in million)	951	
5		Amount of Bills Collected (Rs. in million)	880	
6				
7				
8				Wate
9			Domestic	Commer
10		(Shortfall) - in million	=C4-C5	

COLLECTION EFFICIENCY ASSESSMENT

15

Step 2: Calculation of Collection Shortfall (Rs.) (Cont'd)

For calculating the shortfall for all the consumer categories, hover the mouse pointer on the bottom right of the cell cursor in which the formula has been used in sub-step 1. The pointer would change into the **black bold plus sign**. Drag the cursor to cover all the consumer categories:

Water			Sewerage			Total		
Domestic	Commerical	Industrial	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial
71								

The formula would automatically get pasted into the adjacent cells. The desired output shall be as follows:

	Water			Sewerage			Total		
	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial
(Shortfall) - in million	71	24	34	88	24	7	159	48	41

COLLECTION EFFICIENCY ASSESSMENT

16

Step 3: Calculation of Collection Efficiency (%)

1) Repeat step 1 and give the caption of "**Collection Efficiency (%)**" near the copied headers.
2) Under each consumer category, against the Row label as captioned above, **calculate the collection efficiency** using the formula as shown below.

	A	B	C
1			
2			
3			Domestic
4		Amount of Bills Issued (Rs. in million)	951
5		Amount of Bills Collected (Rs. in million)	880
6			
7			
8			
9			Domestic
10		(Shortfall) - in million	71
11			
12			
13			
14			Domestic
15		Collection Efficiency (%)	=C5/C4
16			

COLLECTION EFFICIENCY ASSESSMENT

17

Step 3: Calculation of Collection Efficiency (%) (Cont'd)

1) Repeat sub-step 2 of step 2 to copy the formula to the adjacent cells to compute collection efficiency for all the consumer categories. Following is the desired output.

Water			Sewerage			Total		
Domestic	Commerical	Industrial	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial
0.925640456	0.781555827	0.65	0.904403047	0.785262261	0.92	0.915177908	0.783391584	0.773

2) Selecting the entire row and convert all the efficiency figures into **percentage equivalent.** Key - "**Ctrl + Shift + %**"

Water			Sewerage			Total		
Domestic	Commerical	Industrial	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial
93%	78%	65%	90%	79%	92%	92%	78%	77%

COLLECTION EFFICIENCY ASSESSMENT

18

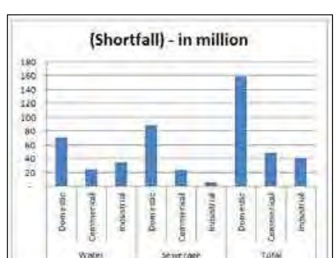
Step 4: Creation of Column Charts - Shortfall

1) Select the entire table containing the values of collection shortfall for each consumer category as shown below:

	Water			Sewerage			Total		
	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial
(Shortfall) - in million	71	24	34	88	24	7	159	48	41

	Water			Sewerage			Total		
	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial
Collection Efficiency (%)	93%	78%	65%	90%	79%	92%	92%	78%	77%

2) Insert tab, click **"Column"** in the section titled, **"Charts"**. Click the first 2-D column chart type to generate a 2-D column chart. The following would be the resulting graph generated.

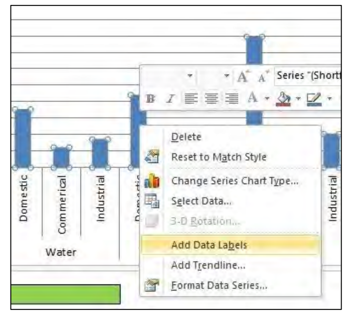


COLLECTION EFFICIENCY ASSESSMENT

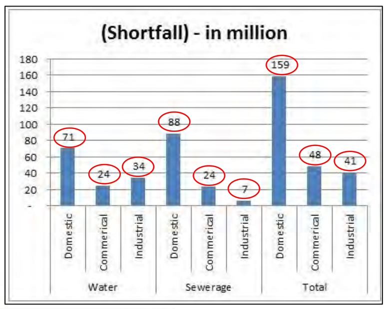
19

Step 5: Managing the chart style/data/format

1) Right-click on any column to generate a drop-down menu. Click on the option, **"data labels"** to add the data labels.



2) After adding data labels, the graph would have the following outlook.



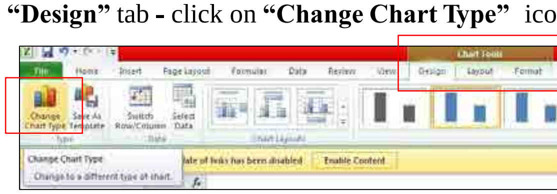
COLLECTION EFFICIENCY ASSESSMENT

20

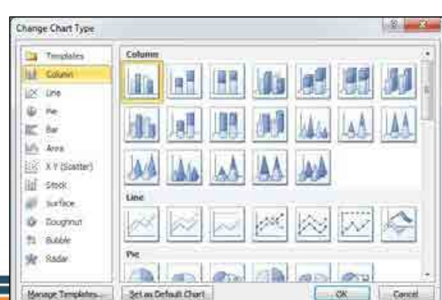
Step 6: Managing the chart style/ data/format (Cont'd)

1. If chart type is to changed, Chart type can be changed once.

Chart Tools - **"Design"** tab **-** click on **"Change Chart Type"** icon.



2. The following dialogue box would appear from which the requisite template can be selected.

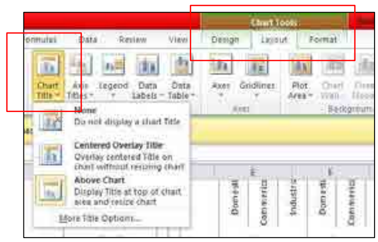


COLLECTION EFFICIENCY ASSESSMENT

21

Step 5: Managing the char t style/ data/for mat (Cont'd)

1) Addition/deletion/alignment adjustment of **Chart Title** using **"Chart Title"** icon in **"Layout"** Tab of **"Chart Tools"** option on title bar.



2) **Data labels** can be added, deleted or aligned using the **"Layout"** tab by clicking on "Data Labels" icon.

3) **Axis titles** can be added, deleted or aligned using the **"Layout"** tab by clicking on "Axis Titles" icon.

4) **Axis labels** can be added, deleted or aligned using the **"Layout"** tab by clicking on "Axis" icon

5) **Data Table** can be annexed to the horizontal axis using the **"Data Table"** icon

COLLECTION EFFICIENCY ASSESSMENT

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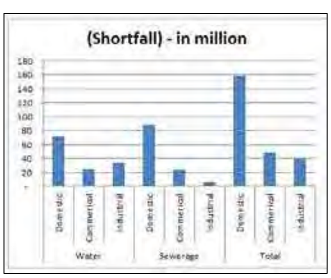
Step 6: Analysis (Identification of GAPs) on final output

Output Graphs



Output Graph for Collection Efficiency (%)

?

Data Tables

	Water			Sewerage			Total		
	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial
(Shortfall) - in million	71	24	34	88	24	7	159	48	41

	Water			Sewerage			Total		
	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial	Domestic	Commerical	Industrial
Collection Efficiency (%)	93%	78%	65%	90%	79%	92%	92%	78%	77%

23

COLLECTION EFFICIENCY ASSESSMENT

ACTIVITIES & GROUP EXERCISE

1. **ACTIVITY B-13:** Creation of column chart for Collection Efficiency (%).
2. **ACTIVITY B-14:** Application of entire exercise on "Number of Bills"
3. **Group Exercise B-16:** GAP analysis and Target setting for Collection Efficiency.

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COLLECTION EFFICIENCY ASSESSMENT

B:13 - INDIVIDUAL ACTIVITY

Repeat step 4 on collection efficiency table to:

a) **Create the graph** of your choice and:

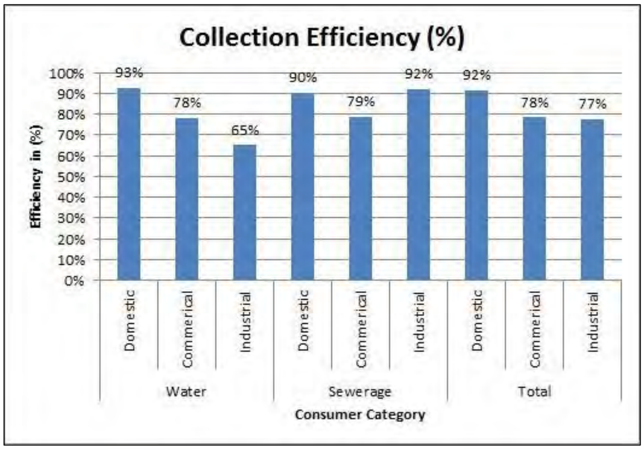
a) Add **Data Labels**;
b) Align Chart Title as "**Above Chart**"; and
c) Display Vertical and Horizontal axis titles

(Time Available: 15 minutes)

25

COLLECTION EFFICIENCY ASSESSMENT

ACTIVITY 3: OUTPUT



26

COLLECTION EFFICIENCY ASSESSMENT

B-14: INDIVIDUAL ACTIVITY

Repeat all 5 steps on number of bills data to:

a) Compute the **Collection Shortfall (No.)** in tabular form.
b) Compute the **Collection Efficiency (%)** in tabular form.
c) **Create the graph** of your choice that compares "total number of bills issued" and "total number of bills collected" and:

a) Add **Data Labels** to the columns;
b) Insert and align Chart Title as "**Above Chart**"; and
c) Display Vertical and Horizontal axis titles

(Time Available: 20 minutes)

COLLECTION EFFICIENCY ASSESSMENT

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ACTIVITY 4: OUTPUT

Collection Efficiency Chart

Collection Efficiency Table

Total No. of Bills Issued	3,990,429
Total No. of Bills Collected	2,548,040
(Shortfall)	1,442,389
Collection Efficiency (%)	64%

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COLLECTION EFFICIENCY ASSESSMENT

B:16 - GROUP EXERCISE

GIVEN

1. **Shortfall** in monetary terms
2. **Shortfall** in numeric terms
3. **Collection efficiency (%)** – Amount of Bills
4. **Collection efficiency (%)** – Number of Bills

GROUPS FORMATION

Four (4) Groups will be formed

Each Group will represent their respective Utility preferably

REQUIRED

1. Enumerate possible reasons for collection inefficiency (**GAP Analysis**)
2. Perform **Target Setting** for the **Collection Efficiency (%)** in **amount of bills** and **number of bills** for the next 3 years.

(Time Available: 30 minutes)

COLLECTION EFFICIENCY ASSESSMENT

GROUP EXERCISE FORMAT: B-16

Sr. No.	Reasons for discrepancy	Priority			
		Critical	High	Medium	Low
1					
2					
3					
4					
5					
6					
7					
8					

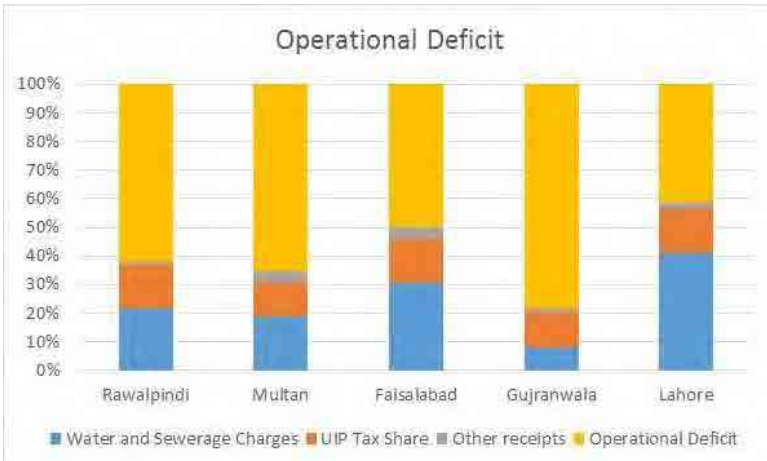
BUDGETARY STRUCTURE ANALYSIS & DEFICIT ASSESSMENT

GROUP EXERCISE FORMAT: Target Setting

			Target		
Indicator	Unit	Current Status	2017-18	2018-19	2019-20
Collection Efficiency (Physical)	%				
Collection Efficiency (Financial)	%				

BUDGETARY STRUCTURE ANALYSIS & DEFICIT ASSESSMENT

30



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THANKS

IDAMP Targets

Sr. No.	Indicator	Unit	Description	Base Line Lahore	Rawalpindi	Gujranwala	Faisalabad	Multan
1	**Service Coverage**							
1.1	Water Coverage	%	Percentage of population with access to water services in comparison to total population	90	85	42	70	55
1.2	Sewerage Coverage	%	Population with sewerage services (direct service connection)as a percentage of the total population	90	30	75	75	65

Sr. No.	Indicator	Unit	Description	Base Line Lahore	Rawalpindi	Gujranwala	Faisalabad	Multan
2	**Water Production and Consumption**							
2.1	Water production	GPCD	Total annual water supplied to the distribution system (ex-treatment plant and including purchased water, if any) expressed by population served per day.	72	181.6	127.02	195	206.33
2.2	Water consumption	GPCD	(Total annual water sold + Total annual volume of free supplies) expressed by population served per day	45	127	77.59	125	206.33

Sr. No.	Indicator	Unit	Description	Base Line Lahore	Rawalpindi	Gujranwala	Faisalabad	Multan
3	**Non-Revenue Water/ Water Loss**							
3.1	Unaccounted for water	%	Difference between total water produced (ex treatment plant) and total water consumed (which is water sold plus free supplies) expressed as a percentage of total water produced.	37	30	39.01	-	-
3.2	Non-revenue water	%	Difference between total water produced (ex treatment plant) and total water sold expressed as a percentage of total water produced.	41	32	39.01	-	22

Sr. No.	Indicator	Unit	Description	Base Line Lahore	Rawalpindi	Gujranwala	Faisalabad	Multan
4	**Metering Practices**							
4.1	Proportion of functional meters	%	Total number of water connections with functional/operating meters expressed as a percentage of total number of metered water connections	5.86	-	0	-	-
4.2	Metered water supply	%	Volume of water sold that is metered expressed as a percentage of total volume of water sold	5	-	0	-	-

Sr. No.	Indicator	Unit	Description	Base Line Lahore	Rawalpindi	Gujranwala	Faisalabad	Multan
5	**Operational Performance / Pipe Network Performance**							
5.1	Pipe breaks	Breaks /Km	Total number of pipe breaks per year expressed per km of the water distribution network.	0.225	0.2	0.096	-	2.52
5.2	Sewerage blockages	Blockages /Km	Total number of blockages per year expressed per km of sewers	34	2.5	26.32	0.28	4.5
5.3	Pipe leakages	Leakages /Km	Total number of pipe leakages per year per km of the water distribution network	3.78	0.25	3.05	2.16	2.52

Sr. No.	Indicator	Unit	Description	Base Line Lahore	Rawalpindi	Gujranwala	Faisalabad	Multan
6	**Cost and Staffing**							
6.1	Unit operational cost - water sold (production cost at consumer end)	Rs. /m^3	Total annual operating expenses divided by the total annual volume of water sold.	16.44	16.21	16.4	13	11.6
6.2	Unit operational cost - water produced (gross production cost)	Rs. /m^3	Total annual operating expenses divided by the total annual water of water produced.	9.7	7.8	9.7	9.18	11.61
6.3	Staff per 1000 water and sewerage connections	Ratio	Total number of staff expressed as per thousand water and sewerage connections	5.44	10	5.94	6.86	5.23

Continue

Sr. No.	Indicator	Unit	Description	Base Line Lahore	Rawalpindi	Gujranwala	Faisalabad	Multan
6.4	Water supply staff per 1000 water connections	Ratio	Total number of water supply staff expressed as per thousand water connections	5.61	10	5.94	4.59	4.51
6.5	Sewerage staff per 1000 sewerage connections	Ratio	Total number of sewerage staff expressed as per thousand sewerage connections	5.26	5	5.94	3.6	5.493
6.6	Salary cost as proportion of Operating costs	%	Total annual salary costs (including salaries, wages, pensions, other benefits, etc.) Expressed as a percentage of total annual operating costs.	35.7	17	44%	47.9	48.86
6.7	Power and Electricity Costs as proportion of Operating Costs	%	Total annual power/electricity costs of the utility expressed as a percentage of total annual operating costs.	43.31	43.8	47%	43.94	47.27

Sr. No.	Indicator	Unit	Description	Base Line Lahore	Rawalpindi	Gujranwala	Faisalabad	Multan
7	**Water Quality**							
7.1	Chemically Unfit Water Samples at Tap	%	Total number of chemically unfit water samples at tap expressed as a percentage of total samples taken	3.164	-	2.94	4.26	85
7.2	Biologically Unfit Water Samples at Tap	%	Total number of biologically unfit water samples at tap expressed as a percentage of total samples taken	9.11	2	7.98	4.26	-
7.3	Water Quality - Samples having residual chlorine	%	Total no of residual chlorine samples that passed the relevant standard expressed as a percentage of Total no of residual chlorine samples carried out	39	35	78	96.1	-

Sr. No.	Indicator	Unit	Description	Base Line Lahore	Rawalpindi	Gujranwala	Faisalabad	Multan
8	**Quality of Services**							
8.1	Water Supply Complaints	%	Total number of water supply complaints per year expressed as a percentage of the total number of water supply connections.	2.15	1.5	3.87	0.86	6.53
8.2	Sewerage Complaints	%	Total number of sewerage complaints per year expressed as a percentage of the total number of sewerage connections.	23.53	2.1	18.67	1	11.24
8.3	Waste water Treatment – Primary	%	Proportion of collected sewage that receives primary treatment only, i.e. involving settlement with the intention of removing solids, but not biological treatment. Both lagoon and mechanical treatment can be included, where appropriate.	0	-	0	0	-
8.4	Waste water Treatment – Secondary	%	Proportion of collected sewage that receives at least secondary treatment, i.e. removing oxygen demand as well as solids, normally biological. Both lagoon and mechanical treatment can be included, where appropriate.	0	-	0	5.91	-

Sr. No.	Indicator	Unit	Description	Base Line Lahore	Rawalpindi	Gujranwala	Faisalabad	Multan
9	**Billings & Collections**							
9.1	Average Revenue of Water & Waste water	Rs. / m^3	Total operating revenue divided by total water sold	7.48	4.1	113.03	7.25	3.11
9.2	Collection Period	months	Year-end accounts receivable/Total annual operating revenues expressed in months equivalent of sales.	15.78	12	7.75	57	-
9.3	Billing Efficiency	%	Total no. of bills issued and delivered at door step expressed as a percentage of Total connections (water +waste water)	96	100	100	99.91	90
9.4	Collection Efficiency (Physical)	%	Total number of bills paid expressed as percentage of total number of bills issued	64	65	67	27.23	30.42
9.5	Collection Efficiency (Financial)	%	Total amount of bills received expressed as a percentage of total amount of bills issued	85	76	67	69.131	57

Sr. No.	Indicator	Unit	Description	Base Line Lahore	Rawalpindi	Gujranwala	Faisalabad	Multan
10	**Financial Performance**							
10.1	Operational cost coverage	Ratio	Total annual operational revenues/Total annual operating cost	0.454	0.2	0.79	0.56	0.26

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Thank you

HDPE Pipes Rates (Lahore)	
4	351.64
5	412.28
6	485.04
8	703.28
10	1057.8
12	1701.1

Asbestos Cement Pipes Rates	
Pipe Size "	rates
3	719.8
4	935.15
6	1479.1
8	2484.05
10	3380.05
12	4465.75
14	6396.4
16	8133.3
18	10117.1
20	12447.65
24	17178.1

WASA	Baseline (Good) %age Length	Baseline (Good) Length m	Gap %age Length	Gap Length m	Possible Targets Phase 1 (30%)	Possible Targets Phase 2 -50%	Possible Targets Phase 3 -30%	Actual Targets Phase 1	Actual Targets Phase 2	Actual Targets Phase 3
Lahore			61.07	2740224	822067	1370112	548045			
Gujranwala			76.99	390058	117018	195029	78012			
Multan			61.18	126637	37991	63319	25327			
Rawalpindi			96.82	694370	208311	347185	138874			
Faisalabad			9.56	1481	444	741	296			

1

MODULE - 1

Business Planning & GAP Analysis

PHNOM PENH WATER SUPPLY COMPANY (PPWSA)

Mr. Yasuyuki Kuroda
Water Utilities Management Expert

2

THE BENEFICIAL PRACTICES OF PHNOM PENH WATER SUPPLY COMPANY (PPWSA)

PLEASE WATCH THE VIDEO IN THE FOLLOWING SLIDE

NOTE
While you watch the video, please try to relate and prepare answers for the following questions relating the video

VIDEO PERTINENT QUESTIONS

1. How many consumers with ID in your WASA?
2. How many consumers without ID in your WASA?
3. How many illegal connections in your WASA?
4. How to prevent water leakage or overflow in your WASA?

OUTLINE OF PHNOM PENN WATER SUPPLY AGENCY IN THE YEAR 1992

4

- Low quality piped water at very low pressure
- Limited supply: 10 hour a day
- 20 % of Phnom Penh residents
- Non revenue water: 72% due to illegal connections, leakage
- Extremely low tariff
- Underpaid staffs
- No metering
- Less than half of bills were collected

STRONG LEADERSHIP BY A NEW MANAGING DIRECTOR

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- Staffs engaged in corrupt activities were fired
- Bill payment were enforced
- Illegal connections were regularized
- Metering was introduced
- Autonomy gained in financial and personnel matters
- Water quality improvement: the MD said “if you get stomachache after drinking the tap water, I will pay you compensation”
- Tariff increase in 1994, 1997, 2001, full cost recovery, get a profit to increase staff salary
- Subsidized tariff to poor communities

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IMPROVEMENT OF BENCHMARKS

Indicators/ year	Year 1993	Year 1999	Year 2003	Year 2009
Phnom Penh population	680,000	880,000	1,030,000	1,440,000
Water supply coverage	25%	62%	82%	90%
Connections	26,881	60,482	105,777	191,092
Water supply capacity (m3/day)	65,000	120,000	235,000	300,000
Water supply pipe length (km)	288	455	921	1,500
Water quality standards	unknown	unknown	WHO guideline	WHO guideline
Water supply pipe net work pressure	0.2	2.0	2.5	2.5
Water supply duration a day (hours/ day)	10	24	24	24
Non Revenue Water (NRW)	72.0%	48.5%	17.1%	5.9%
Staff per 1, 000 water supply connections	22.0	7.8	3.9	3.2
Water supply charge collection rate	48.0%	98.9%	99.8%	99.9%

Source: Miracle of Phnom Penh, March 2015, Kuwajima/ Suzuki, JICA

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B-115: GROUP DISCUSSION

GROUPS FORMATION

1. Four (4) Groups will be formed
2. Each Group will represent their respective Utility preferably

REQUIRED

1. Discuss what good practices could be applied at their WASA, e.g.
   - Increase of connections
   - Dialogue with consumers
   - Improvement of water quality
2. How to measure to what extent you improve the above works.

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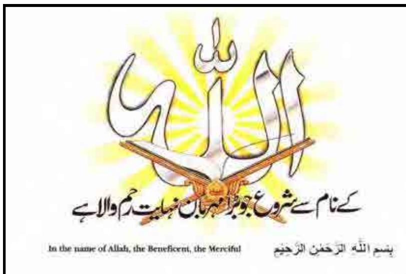
THANKS

1



Business Planning & GAP Analysis

Integrated Development & Asset Management Plan (IDAMP)

Asif Iqbal
Financial Management Specialist

ALJAZARI ACADEMY

BUSINESS PLANNING

2

Purpose
- Vision/ Mission
- SWOT

Gaps
- Assets
- Level of Service (KPIs)

Action Plan
- Identification of Projects
- Screening, Phasing and Approval

ALJAZARI ACADEMY

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WHAT IS INTEGRATED DEVELOPMENT & ASSET MANAGEMENT PLAN?

INTRODUCTION/ PURPOSE

- Midterm (3 year) rolling Planning & Asset Management Tool.
- Annual development plan (ADP) will become Objective and result oriented.
- Evidence based planning creates linkage between (level of services (Los) with development and non development activities within a city.
- Helps entities better justify expenditure needs.
- Leads policy makers to better monitoring of performance of entities

How Do You Plan?

A. **Development?**

B. **Non-Development/ Asset Management?**

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ANNUAL DEVELOPMENT PLAN

DATE	ACTION
January, 2016	Circulation of ADP guidelines
1st Feb to 15th March	Submission of scheme-wise first draft ADP to the Planning & Development by the departments duly cleared by Minister In-charge.
16-25 March	Scrutiny of draft ADP by the Members P&D and submission to Coordination Wing of P&D Department
26 March to 7 April	Departmental meetings / briefing with Chairman, P&D to discuss draft ADP
10th April	Submission of 2nd draft ADP to P&D by the Departments
Up till 15 May	Approval of new schemes proposed for inclusion in ADP by the competent forum

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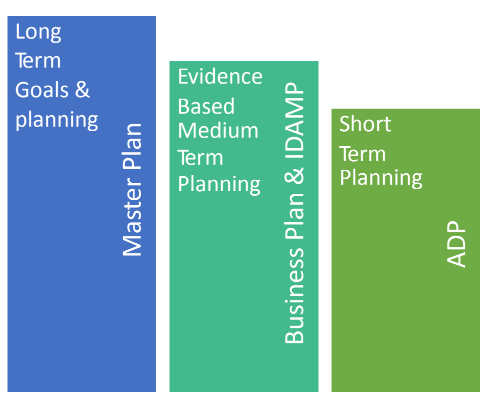
Do you link ADP Schemes to Level of Services?
Is ADP process an Evidence Based Planning?



Methodology of IDAMP

The following steps have been formed after reviewing international literature and practices including iso 55000, cdia toolkit, world bank literature etc;

Step 1	Development of GIS based Asset Inventory
Step 2	Notification of Level of services (LOS)
Step 3	Development of Project Proposal
Step 4	Preparation of Operational & Maintenance (O&M) Costs
Step 5	Compilation of Project Package
Step 6	Financial Capacity Analysis
Step 7	Projects selection and approval
Step 8	Capital Investment Plan
Step 9	Finalization of Integrated Development & Asset Management Plan

Step1: Development of GIS based Asset Inventory

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Asset Inventory – WASAs

1. Pipelines (Water Supply and Sewerage)
2. Tube wells
3. Disposal Stations & Disposal Pumps
4. Water Treatment Plants
5. Overhead Reservoirs
6. Machinery & Equipment
7. Vehicles
8. Land
9. Buildings

Below Ground

Above Ground

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Sources of Inventory

1. Below Ground:
   - A Comprehensive Database is formed for all 5 WASAs by UU and Respective WASA.
   - Updated and endorsed in IDAMP
2. Below Ground:
   - AMIS with attributes like cost, life, risk, condition, replacement year etc
   - Updated and endorsed in IDAMP

Microsoft Excel Worksheet

Regular updation is required

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STEP 2: NOTIFICATION OF LEVEL OF SERVICES

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LOS

Assets

Microsoft Excel Worksheet

LOS - WASA

Microsoft Excel Worksheet

Business Planning B1131 Module 1 : Business Planning & GAP Analysis Session 2

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STEP 3: DEVELOPMENT OF PROJECT PROPOSALS

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After completing and updating Existing Inventory record and performance targets, Asset Managers shall assess; what shall be done to achieve those targets. To fulfill the service delivery gap between existing LOS and target LOS, Asset Manager shall identify projects to be done to achieve the target. Asset Manager shall develop project proposal. Project Proposal shall include the following activities:

1. Projects Identification
2. Preparation of Projects
3. Project Appraisal
4. Project Screening and Phasing

Further all the projects identified need to be mapped on GIS system for the identification of respective project lines/area.

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Condition	Failure Risk State			
	Low	Moderate	High	Significant
A	Regular Maintenance	Regular Maintenance	Preventive Maintenance	Priority Maintenance
B	Regular Maintenance	Preventive Maintenance	Priority Maintenance	Priority Rehabilitation
C	Preventive Maintenance	Priority Maintenance	Priority Rehabilitation	Immediate Rehabilitation
D	Priority Maintenance	Priority Rehabilitation	Immediate Rehabilitation	Immediate Replacement
E	Priority Maintenance	Immediate Rehabilitation	Immediate Replacement	Immediate Replacement

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PROJECT PROPOSAL FORM

- The following project proposals format is used by Asset Managers for each project:

Microsoft Excel Worksheet

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	Criteria description
1	**Project Purpose** ▪ Does the project fill a gap in a wider system of service delivery? ▪ Whether the existing services are dealing with the problem? ▪ Whether the project will contribute to city master plan/ regional development goals? ▪ Whether the deference/ delay of the project is going to affect citizens' health, safety, property, prosperity etc.?
2	**Public Response & Service Delivery Improvement** ▪ Is the project likely to get support from municipal leadership? ▪ Will the project get approval from higher levels of entity? ▪ Does the project have a local 'champion' or where did the project idea originate from? ▪ Is there support or opposition from residents, NGO's and community groups in the immediate vicinity of the proposed facility/ project?

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	Criteria description
3	**Environmental Impact** ▪ Does the project provide any benefits to the quality of public spaces in the city e.g. parks, green infrastructure, water bodies, boulevards, open spaces, etc.? ▪ Does the project confer direct benefits to the quality of the local environment e.g. air quality, water pollution, waste reduction, etc.? ▪ Does the project fulfill the prescribed requirements of environmental and social screening and impacts identification as per Pakistan Environmental Protection Act, 1997?
4	**Socio-Economic Impact** ▪ Does the project bring improvements to low income neighborhoods? ▪ Does the project contribute to a more harmonious society? ▪ Will the project bring in direct revenue?

	Criteria description
4	**Socio-Economic Impact** ▪ Does the project has acceptable economic appraisal/ cost effectiveness? ▪ Are there indirect economic benefits from this project in the long term, e.g. employment creation, investment generation, increase in land/property prices, reduction in citizens' expenditures, etc.?
5	**Project Feasibility of Implementation** ▪ Ease of implementation of project in respect of technical design? ▪ Has an institutional needs assessment been carried out with regard to planning, implementing and managing the proposed infrastructure? ▪ Will the external factors negatively impact the outcome of the proposed project? ▪ Is there a capable system in place to implement and operate this project or is external support needed? ▪ Is the project feasible as per IEE/ EIA studies?

STEP 4: PREPARATION OF OPERATION & MAINTENANCE (O&M) COSTS

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The operation and maintenance (O&M) costs will be compiled on basis of Asset Management Plan and computed for all the assets by the respective Asset Managers. The O&M costs is bifurcated into following sections:

1. O&M costs of existing assets
2. O&M costs of the proposed projects.

- Annual O&M shall include Staff costs, Fuel cost, Electricity costs and Repair & Maintenance Cost for all existing and proposed assets.

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O&M FORM

The following performa/ Form is used for calculation of O&M cost:

For example O&M for tube well:

Microsoft Excel Worksheet

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STEP 5: COMPILATION OF PROJECT PACKAGE

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After completion of above mentioned steps, Asset Manager shall consolidate this working to produce a Project Package. Project Package shall include following at minimum;

1. Screened Project along with allocated score
2. O&M Cost along with AMP
3. Supporting Document(s) that are used by Asset Manager to allocate score

Asset managers shall submit their Project Package to the IDAMP Technical Team for evaluation and approval

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STEP 6: FINANCIAL CAPACITY ANALYSIS

WASAs shall analyze potential financial sources, financial health of organization, operational sustainability and criticality of Service Delivery.

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Step 7: Project Selection & Approval

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Once Planning Department of WASAs has analyzed the potential financial sources and received Project Package from Asset Managers, these shall be presented to Technical Team for selection of projects.

Technical Team shall evaluate the proposed projects against following factors and score to each project

1. Relevance
2. Short Term Assumptions Performance
3. Efficiency
4. Effectiveness
5. Sustainability

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STEP 8: CAPITAL INVESTMENT PLAN

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After having the details of existing and proposed assets, requirements of their operations and maintenance, current and desired level of service delivery, WASAs will prepare their Capital Investment Plan.

Capital Investment Planning involves the following activities:

- Identification of sources of financing
- Assessment of Own Source Revenue
- Assessment of Available Government Grants/ External Financing
- Prioritization of available funds.

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STEP 9: FINALIZATION OF INTEGRATED DEVELOPMENT & ASSET MANAGEMENT PLAN

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Finalized Assets shall be compiled in the Form of IDAMP Budget Book

IDAMP budget book shall include the budgeted development expenditures and associated non development expenditures.

Finalized IDAMP book shall be approved and authorized by the competent authority

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IMPLEMENTATION OF PROJECTS AS IDENTIFIED IN IDAMP

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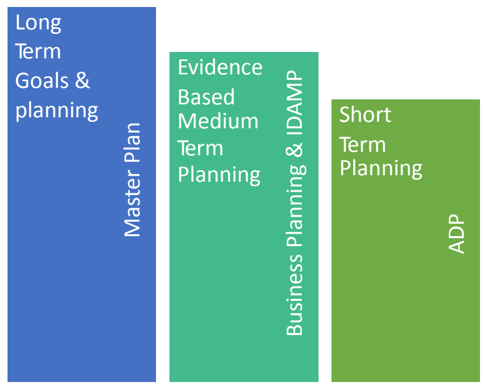
Do you link ADP Schemes to Level of Services? Is ADP process an Evidence Based Planning?



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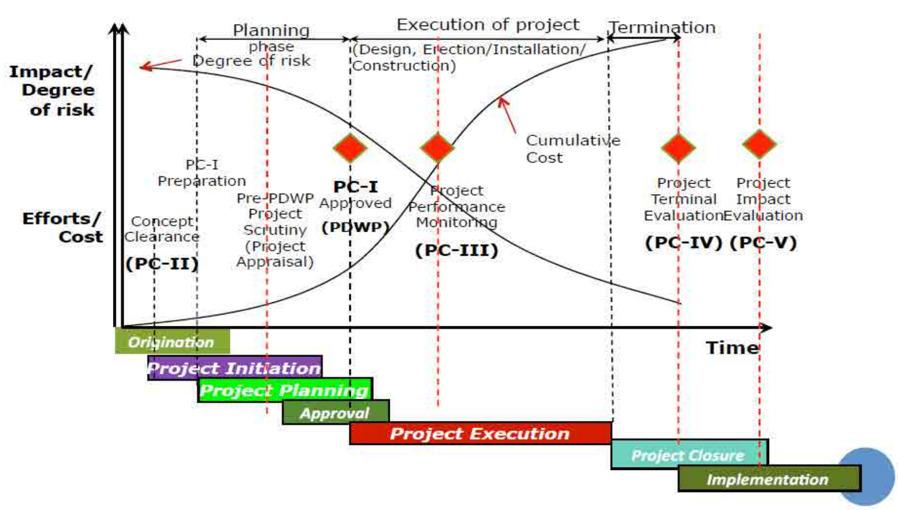
PROJECT CYCLE MANAGEMENT (1/2)



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PROJECT CYCLE MANAGEMENT (2/2)

PC-I Detailed project document

PC -II For preparation of pre-feasibility and feasibility surveys

PC-III For submission of monthly/annual monitoring/progress report of project

PC- IV For submission of completion report of Project

PC -V For submission of evaluation/implementation report on annual basis for five years

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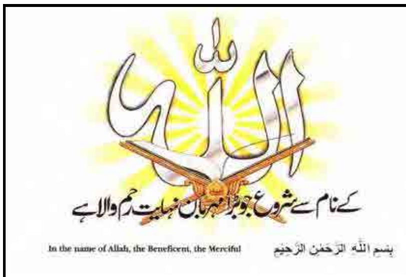
Questions?

1



Strategies for Improvement
Performance Improvement Plan

Water Supply

Abid Hussiny &
Aneeqa Azeem

What is a Strategy ?

- a plan of action designed to achieve a long-term or overall aim.
- A method or plan chosen to bring about a desired future, such as achievement of a goal or solution to a problem.

What is our strategy based on the gap analysis to achieve our kPI of Water supply or improve water supply operations and service delivery

Group Work

Strategies

1. Pressurised system is introduced –OHR
2. 24/7 is introduced – selection of area
3. Removal of all illegal connections and suction pumps that people install on the water mains.
4. Effective billing and collection system
5. Effective O&M System & Monitoring system

Strategies

1. Water Quality Monitoring system
2. Effective complain management system
3. Leakage detection program
4. Asset Replacement Plan of Poor or non performing asset
5. Efficiency of tube wells is improved

Group work

- Select any 5 strategies'
- Add any strategy you wish to use
- Match strategies to your SWOT
- Check with mission and statement
- On the Map of zone or sub division select area and mark the strategy to be implemented

Step

- Map or select Sub Division /Area
- Location of OHR and pressurised system
- Location of 24/7 zone
- Location of leakage detection program
- Selection of replacement area lines, TWs etc
- Area of water quality samples
- Illegal connections
- After completing the exercise – Check the work of same sub division in the IDAMP

Prepare Performance improvement Plan

- Discuss the Framework
- Start working on the Framework of PIP based on selected area and strategies

Example- demonstration

- O&M system for WASAs
- AMIS System for WASAs
- Consumer Survey for WASAs
- GIS system for WASAs

2

Service Improvement by Replacement & Extension of Water Supply Network

Steps:

1. **Marking of lines to be replaced on GIS base map**
2. **Marking of New lines on GIS base map for improving % of water supply coverage**
3. **Tube well Rehabilitation**
4. **Operationalization of OHRs**
5. **Making Project in phased manners**
6. **Costing of Projects based on pipe length**

3

Costing

Project Cost

Water Supply Pipe replacement or New Installation

Diameter	Length	Unit Cost (Per meter)	Pipe Cost (A)	Construction Cost (B)	Total Cost (A+B)
3"					
4"					
6"					

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1

Performance Improvement Plan

Sewerage System

Abid Hussany , Ali Rao & Aneeqa Azeem
Research Analyst

ALJAZARI ACADEMY

Strategies

1. Sewerage System cleaning
2. Drains De-silting
3. Removal of sewerage blockage
4. Effective use of sucker and jetting machine
5. Replacement of pipes
6. Disposal station maintenance
7. Pumps maintenance
8. Machinery maintenense

Strategies

1. Water Quality Monitoring system
2. Effective complain management system
3. Leakage detection program
4. Asset Replacement Plan of Poor or non performing asset
5. Efficiency of tube wells is improved

Group work

- Select any 5 strategies'
- Add any strategy you wish to use
- Match strategies to your SWOT
- Check with mission and statement
- On the Map of zone or sub division select area and mark the strategy to be implemented

Step

- Map or select Sub Division /Are
- Location of DS for improvement
- Location of Pipe Burst
- Selection of replacement area lines, TWs etc
- Area of major accidents
- Manhole covers
- After completing the exercise – Check the work of same sub division in the IDAMP

Prepare Performance improvement Plan

- Discuss the Framework
- Start working on the Framework of PIP based on selected area and strategies

2

Service Improvement by Replacement & Extension of Sewerage Network

Steps:

1. Marking of lines to be replaced on GIS base map
2. Marking of New lines on GIS base map for improving % of Sewerage coverage
3. Disposal station - repair/replacement
4. Making Project in phased manners
5. Costing of Projects based on pipe length

3

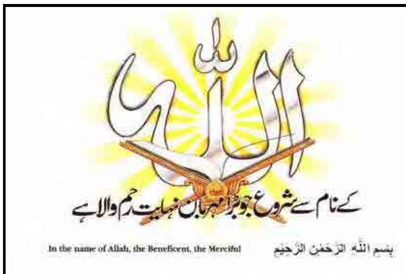
Costing

Project Cost

Sewerage replacement or New Installation

Diameter	Length	Unit Cost (Per meter)	Pipe Cost (A)	Construction Cost (B)	Total Cost (A+B)
6"					
9”					
12”					

1



Business Planning & GAP Analysis

Project Selection and Approval By Technical Committee

Asif Iqbal
Financial Management Specialist

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PROJECT FINALIZATION AND APPROVAL BY TECHNICAL TEAM

Technical Team shall evaluated and approved the projects on basis of following criteria;

Criteria 1: ***Relevance***

Criteria 2: ***Short Term Assumption Performance***

Criteria 3: ***Efficiency***

Criteria 4: ***Effectiveness***

Criteria 5: ***Sustainability***

Criteria 1: *Relevance*

Relevance

- Whether the project design is fundamentally suited for achieving the goals associated with the project?
- Whether the proposed project complied with the applicable legal regulations?

Lowest score	Highest score
01	20

5

Criteria 2: *Short Term Assumption Performance*

Short Term Assumption Performance

- Has funding been secured/allocated within the Local Government budget for this project?
- If required then whether the external sources of funding have been secured?

Lowest score	Highest score
01	20

6

Criteria 3: *Efficiency*

Efficiency

- Whether the proposed project is financially and/ or economical viable?
- Whether the proposed project would be able to attain time & cost efficiency?
- Will the proposed project going to improve the overall efficiency of the service delivery?

Lowest score	Highest score
01	20

Criteria 4: *Effectiveness*

Effectiveness

- Does the project contribute towards long term sustainable development, e.g. renewable energy, clean water supply, waste treatment, recycling, etc.?
- Does the project improve the social status and access to social services (health, education, etc.) for women and children?
- Whether the project will be able in achieving the associated ***wide objectives***?

Lowest score	Highest score
01	20

Criteria 5: *Sustainability*

Sustainability

- If there is risk, does the project design include a risk mitigation strategy?
- Whether the proposed project would be able to sustain if external financial or technical support has been withdrawn after completion?

Lowest score	Highest score
01	20

9

Scoring Criteria

Final project score derived on basis of scores allocated by Technical Team and Asset Manager to the individual project. Score given by Technical Team and Asset Manager were clubbed by **70%** and **30%** respectively. Final Approved and Phased List of Projects was prepared as per the following scores schedule;

Cumulative Average Score	Phasing Plan
71 – 100	Year 1 (2016 - 2017)
51 – 70	Year 2 (2017 - 2018)
21 – 50	Year 3 (2018 - 2019)
1 – 20	Rejected
Technical Team score less than 20	Rejected

10

Group Activity:
Role Play

Public Communication Plan

Memoona Arslan Bhatti
Communication Specialist

February 10, 2017

Public Communication Plan – Overview

- Urban Unit has developed this communication plan with an objective to develop and implement a communication strategy for water and sewerage issues while ensuring that we, along with our program partners, spearhead a relentless awareness campaign.
- The proposed vigorous campaigns, fast track dissemination of information as guided by this plan will benefit residents of targeted cities.

Significance of Communication Plan

- Development of harmonized document in order to put in place a comprehensive and accurate referral document providing guidelines which are globally accredited vital for realizing public communication objective of any urban development project.
- Guidelines and key communication specifics, along with the actual activities that will be expected to define the project’s annual calendar.

Effective Communication Strategy

- Ensure the most efficient and effective utilization of resources through a process of prioritization and rationalization
- Provide practice guidelines and clear direction for daily activities
- Identify the drivers of change as well as the best means to engage with them
- Ensure predictability and continuity, while enabling a continuous review of current organizational activities and indicative milestones against which we will measure success.

Elements of Effective Communication Strategy

- Policy Objectives
- Key Audiences of the Plan
- Communication Plan for WASAs
- Specific Approaches

Policy Objectives

- Audiences & their Profiles
- Key Messages
- Channels, Tools and Activities
- Communication's Budget
- Monitoring & Evaluation

Key Audiences of the Plan

Different audiences can be divided into three categories:

- Internal audiences
- External audiences
- Media

All channels of communication and messages have to be tailored accordingly to suit each of these.

Communication Plan for WASAs

Objectives of the Strategy

- To increase awareness, improve knowledge standards and build support for key stakeholders
- To promote positive water and sanitation management practices among all key stakeholders
- To create demand for use of the improved services

Specific Approaches

- Internal communication
- Public participation mechanisms
- multi-media communication program
- Media advocacy
- Capacity building of Institutions

Internal Communication

- Team briefing system
- Interaction facilitation
  with staff to address sensitive issues regarding job, organizational changes etc.
- Special events arrangement for staff
- A quarterly internal newsletter production
- Star of the Month to be announced and celebrated
- Frequent internal meetings
- Briefing documents

Internal Communication

- Consultations sessions
- Use of circular communication process with an emphasis on feedback
- Management debriefing meetings once a month
- Celebrate major accomplishments
- Ensure wide spread availability of information through notices, e-mail communication; newsletter, website and all other channels for purposes of general information
- Provide proper orientation to all new/ incoming staff
- Publish materials including books (if required), reports and various IEC materials of interest to the WASAs and their various stakeholders
- Timely and clear communication to staff

Establishing Public Participation Mechanisms

- Opinion leaders
- Consultation forums
- Establishing WSS forums and celebration of relevant events and days
- Corner meetings with community representatives
- Community-led public participation activities like small gatherings, mini seminars and public speech forums

Media-Communication Program

- Proactive promotion of positive information and campaigns in media
- Develop and maintain good relationships with media
- Participate in radio and TV talk shows
- Organize for press conferences to profile WASAs activities
- Make relevant information timely and newsworthy at all times
- Arrange to write quality write-ups for leading newspapers about reforms in WASAs
- Thematic media campaigns for information of communities
- A multi-media campaign delivered utilizing both paid-for advertisements, earned media and interpersonal channels
- Advertorials and adverts in the print media
- TV and Radio infomercials
- Documentary
- Information materials – posters, brochures
- News and feature articles in both print and electronic media

Media Advocacy

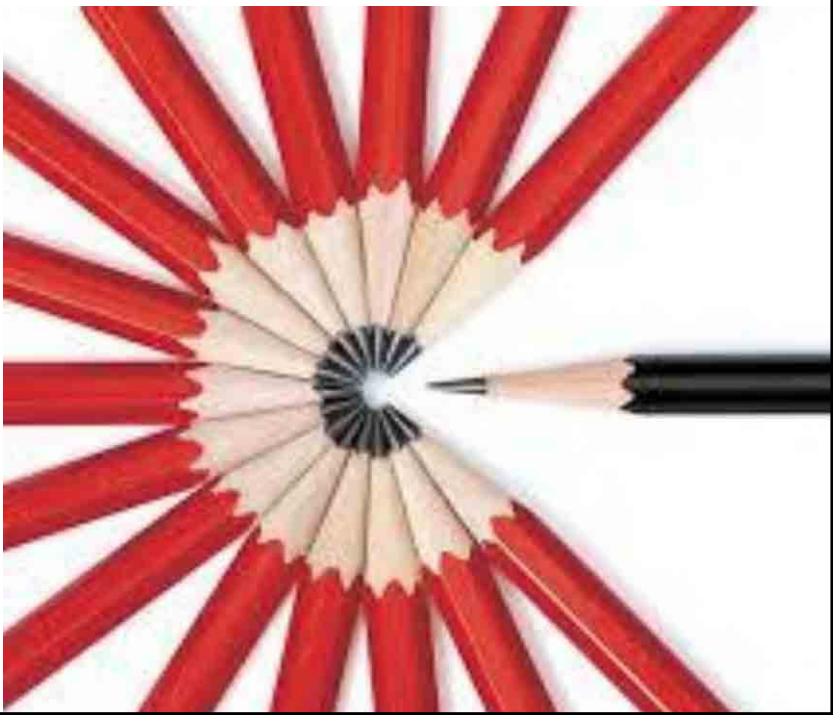
- Build on positive coverage to build the right media content and treatment
- To influence the nature of coverage
- Media training workshops at the national and city levels
- Implementation of advocacy approaches to build support among all
- Confidence building exercises in collaboration with involved partners/departments
- Tailored communication keeping in view the specific needs of each target group
- Jumping onto all possible relevant activities held by other departments/NGOs etc.

Tools for Sector Specific Communication

- Briefing materials
- Seminars and workshops
- Organizational meetings
- Articles in sector publications
- Quarterly progress Newsletters

Branding and Identity

- The agreed logo shall be promoted.
- The brand identity will be projected in all its documents, including, its various types of correspondence, PowerPoint presentations, and advertisements and /or any other form of publicity.



Monitoring and Evaluation

- Close monitoring of media coverage in both print and electronic media
- Stakeholder satisfaction and awareness survey, undertaken during every phase of implementation
- Staff knowledge and satisfaction assessment
- Range, quality and depth of communication products produced for different audience segments
- Delivery of measurable improvements in the quantity of communications delivered through the website and staff intranet
- Increased brand recognition WASAs at local, national, regional and international level
- Delivery of best value communication service, and
- Stronger partnerships and networks established with different institutions other stakeholders and organized groups

Evaluation Indicators

- Number of clips appearing in the newspapers
- TV clips
- Number of appearances and or references in websites and blogs
- Tone of articles, size and prominence
- Number of stakeholder engagement meetings held
- Number of workshops held
- Number of participants

Conclusion

The matrix integrates all aspects of the strategy indicating the logical link between the audience, key message themes, methodology, channels and tools, expected outcomes and implementing partners. Key message themes are based on the objective for communication for each audience and the findings from the assessment. The strategy matches audiences with specific channels depending on the appropriateness of the channel to the specific audience. The approaches combine mass media, community-level activity and interpersonal communication - all linked to specific outcomes.

No.7-1

5. Rural water supply models

Mr. Abuzaid. Mohamed. Ali
Manager of rural water supply department

1

Two rural water supply models

The SWC and Project team have found, through actual O&M of the Pilot Projects in Wad El Helew and Banard Village, that the O&M manner in a small urban area is different from one in a rural village .

	Pilot site	Model
1	Wad El Helew	Large village water supply model
2	Banad, Girba Locality	Small village water supply model

2

Table. The standard for financial management and O&M model

	Model	Population for water supply	Scales of facilities	Condition
1	Large Village Water supply model	More than two thousand (2,000)	• No of source: more than three (3) • Total length of pipe network: total more than 3km	It is realistic to SWC staffs to be stationed in such villages
2	Small Village Water supply model	Less than two thousand (2,000)	• No of source: less than two (2). • Total length of pipe network: total less than 3km	It is not realistic to expect SWC staffs to be stationed in such villages

Table. Demarcations among the SWC, the locality, locality operators and the water committee in two models (6-1, 6-2)

Category		Planning and Implementation of Financial Management						Operation		
		Establishment of Water Committee	Water Fee Setting	Financial Management	Labor Management	Information Campaign		Daily Operation	Fee Collection	Summary Account & Bank Deposit
Model	Position	・Assignment of Water committee leader and menber ・All actors understand the role demacation	Setting the water fee based on conference among the SWC, locality office and water committee	1) Revenues/ expenses forecast 2) Monitoring of actual revenues/expenses	Payment for Local Operators	Hygiene Promotion	Prevention activity for Water Facility	1) Valves open/ close 2) Record of water production quantity 3) Water meter reading	1) Water selling 2) Monitoring for non-payment customers 3) Sales record	1) Summary Account 2) Bank Deposit
Large village water supply Model (Wad el Helew)	SWC	Account Support	Proposal Conference	Accountant		Manager of Laboratory				Checking balance
	SWC Engineer stationed in the Town		(1)		Payment			Supervision, Instruction		1) Auditing 2) Collection 3) Bank Deposit
	Local Operator		(2)		Salary			Operation	Collection	
	Locality Office	Account Support	(3) Conference							Summary Account
	Water Committee	Establishment	Conference				Prevention activity			
	State Government		Approval							
Small village water supply Model (Banad Village)	SWC	Account Support	Proposal Conference	Accountant						1) Auditing 2) Collection 3) Bank Deposit
	Locality Office	Account Support								
	Head of a village	Establishment	(1) Conference							
	Water Committee (Operator)		(3) (2) Conference		Payment		Prevention activity	Operation	Collection	Summary Account
	State Government		Approval							

Table. Demarcations among the SWC, the locality, locality operators and the water committee in two models (6-1, 6-2)

Category		Maintenance					Monitoring	
		Agreement on the SWC model	Small Maintenance		Big repair	Training	1) Round of visit 2)Water quality check	
Model		・Account for the water committee and local operater ・Agreement on the financial management and O&M model	1) Electricity Charge 2) Fuel Cost 3) Exchange of engine oil 4) Replacement of spear parts 5) Cleaning of solar panels, Fountains,	Spear parts purchase	1) leakage repair 2) Pipe replacement 3) Rehabilitation of pipes, pumps, tanks and others 4) Solar panels replacement 5) Securement of the budget and Implementation	1) O&M training 2) Financial training	Inspection of water facilities	Examination of the water quality
Large village water supply Model (Wad el Helew)	SWC	1. Account		Approval	Planning by rural water supply department → Securement of the budget and Implementation	Initial training	Rural water supply department	Manager of Laboratory
	SWC Engineer stationed in the Town		Supervision, Instruction	Planning of procurement; Procurement	Application	OJT	Working together	
	Local Operator		Implementation	Application		Participation		Request
	Locality Office	2. Agreement 3. Account						
	Water Committee	4. Agreement		Application				
Small village water supply Model (Banard Village)	SWC	1. Account		Planning of procurement → Approval → Procurement	Planning by rural water supply department → Securement of the budget and Implementation	Initial training, periodical training	Rural water supply department	Manager of Laboratory
	Locality Office	2. Agreement 3. Account						
	Head of a village	4. Agreement						
	Water Committee (Operator)	4. Agreement	Implementation	Application		Participation		Application

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1. Planning and Implementation of financial Management

Price setting, Financial and Labor management

Large village

SWC

SWC Engineer stationed

Locality

Water Committee

Small village

SWC

Water Committee

1) Valves open/ close
2) Record the water production quantity
3) Water meter reading

2. Operation Daily operation

Large village

SWC Engineer stationed

Supervision, Instruction

Local Operator

Daily operation

Small village

Water Committee = Local Operator

Daily operation

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1) Water selling
2) Monitoring for non-payment customers
3) Sales record

2. Operation Fee Collection

Large village

SWC Engineer stationed → Bank Account

Locality (Accountant Staff)

Local Operator

Fee Collection

Small village

SWC (Accountant) → Bank Account

Water Committee = Local Operator

Fee Collection

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3. Maintenance

Small Maintenance

1) Electricity Charge
2) Fuel Cost
3) Exchange of engine oil
4) Replacement of spear parts
5) Cleaning of solar panels, Fountains,

Large village

SWC Engineer stationed

Supervision, Instruction

Local Operator

Implementation, Application

Water Committee

Application

Small village

SWC

Supervision, Instruction

Water Committee = Local Operator

Implementation, Application

3. Maintenance

Big Maintenance

Large village

SWC
Maintenance Department

Implementation

SWC Engineer stationed

Report, Request

1) Leakage repair
2) Pipe replacement
3) Rehabilitation of pipes, pumps, tanks and others
4) Solar panels replacement
5) Securement of the budget and Implementation

Small village

SWC
Maintenance Department

Planning, Implementation

3. Maintenance

Training

1) O&M training
2) Financial training

Large village

SWC
Training Unit

Implementation

Local Operator
Initial Training
Periodical Training

SWC Engineer stationed
OJT, Training

Small village

SWC
Training Unit

Implementation

Water Committee = Local Operator
Initial Training
Periodical Training

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4. Monitoring

1) Round of visit
2)Water quality check

Large village

SWC
Maintenance Department
Rural water supply Department

SWC Engineer stationed

Planning, Implementation

Small village

SWC
Maintenance Department
Rural water supply Department

Planning, Implementation

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Recommendations to for future actions

- The SWC shall establish a rural water supply system, in cooperation with water committees, residents, locality offices and donors: a rural water facility baseline survey, prioritization, long list formulation, construction/ rehabilitation plan formulation, fund raising, operation/ maintenance and monitoring.

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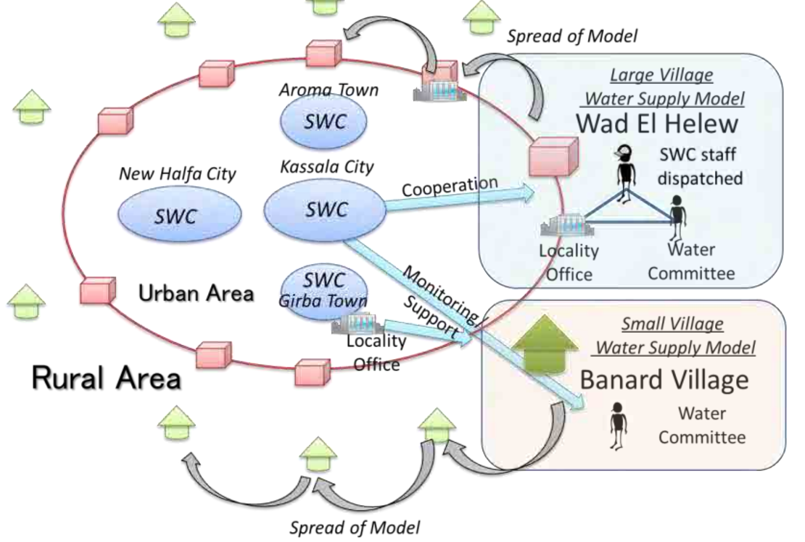
Recommendations to for future actions



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Recommendations to for future actions

- Residents shall establish a water committee before new construction or rehabilitation of rural water facilities in their villages or cities.
- The water committees, residents, SWC and locality offices shall discuss to establish an operation/ maintenance system, water tariff and employ operators before the construction or rehabilitation completion.

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Thank you very much for your attention !!

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DRAFT

ALJAZARI ACADEMY

Business Planning

Course Code: B1131

Business Planning & GAP Analysis
Module 1

INTRODUCTION TO THE COURSE
Participant Notes

2017

Table of Contents

Lecture No. 1

Module Grid:

Learning Outcomes:	Lecture Duration:
Learning Outcomes: **LO1:** Introduction to the Course **LO2:** Introduction to the Module **LO3**: Understanding of Business Plan and its Components **LO4**: Understanding the objective and application of SWOT, PESTLE and TOWS Analysis with practical insight **LO5**: Understand the Benchmarking concept **LO6**: Understand the KPIs of WSS Utilities **LO7**: Understand BANDs in assessing the quality of data **Skill Set Outcomes:** **LO1:** Calculate KPIs. **LO2:** Prepare Benchmarking Report of their respective WSS Utility	Lecture Duration: [Time] Minutes

Course Overview

The overall structure of the course is as under:
Module 1: Business Planning and GAP Analysis
Module 2: Strategies for Service Delivery Improvements
Module 3: Strategies for Human Resource Development
Module 4: Strategies for Financial Management
Module 5: Business Plan Formulation and Implementation

The approach used by the trainers throughout the training course shall be:

- Lectures
- Individual Assignment
- Group Assignment
- Lab Activities
- Case Studies
- Videos
- Field Visit
- On-Job-Training
- Final Project

Course Outcome

As the participants will be divided into groups and allocated respective sub-divisions therefore throughout the training period the participants will be engaged in preparation of:

- SWOT Analysis and Benchmarking Report
- Action Plans for Service Delivery Improvement
- Human Resource Development
- Financial Management
- Business Plan and IDAMP

Operational plans of the respective sub-divisions shall be formulated which when consolidated would result into the business plan. This business plan would serve as the outcome of business planning course.

B-17: INDIVIDUAL ACTVITY

EXPECTION FROM COURSE

Each Class Participant is requested to fill the following form.

(5 Minutes)

BUSINESS PLANNING COURSE	
Expectation of Class Participants	
Name:	
Designation	
Organization	
Expectation from this Course	
1.	
2.	
3.	
4.	
5.	

Reality Check: Good Performance among Public WSS Utility

Guiding points signifying the good performance among public water supply and sewerage utility are enumerated below.

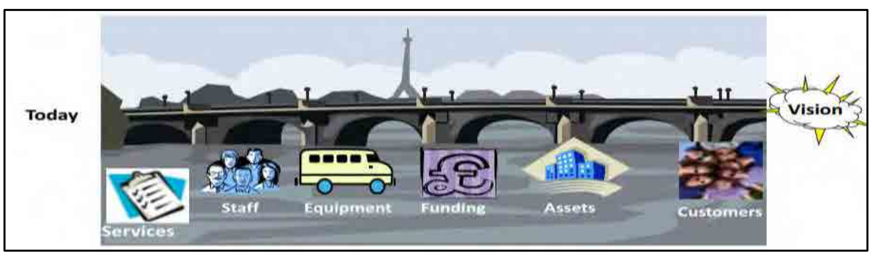
- Reform process in inherently political and requires the full commitment of its policy makers to correctly balance financial & political objectives
- Success is often unattainable without reforming the external environment with emphasis on the role of owner
- Fundamental reforms are not a quick fix and cannot be substituted by private sector participation.
- Certain decisions must be left to utility managers
- Customers can be an important voice for improving performance

BUSINESS PLAN & ITS COMPONENTS

The Business Planning as defined by International Benchmarking Network for Water and Sanitation Utilities in "The IBNET Water Supply and Sanitation Performance Blue Book" is defined as

"A business plan presents a detailed roadmap that can guide a utility from its current condition to a desired future state"

The pictorial representation of the aforementioned concept is given below.



Source : www.gov.scot/Resource/0048/00485457.pdf assessed on 4th Jan 2016

B-18: INDIVIDUAL ACTIVITY

What is the layout of the Business Plan of WSS Utility

(Time Available: 10 minutes)

Sr No.	Major Headings	Sub-Headings
1		
2		
3		
4		
5		
6		
7		
8		
9		

Layout of the Local Business Plan of WSS Utility

Before commencing the preparation of business plan of the course, it is necessary to have an insight into different formats of business plan so that an understanding about the structure and in-depth objective assessment of the business plan can be made. Hereunder have been given the screenshots of sample business plans of different sectors that will assist you in understanding and preparing business plan for the course which is the expected outcome of this course.

Local Business Plan of WSS Utility
Business plan of a WSS utility may include the following main items:

- Executive Summary
- Introduction
- Situation Analysis
- SWOT Analysis
- Vision, Mission and Goals
- Strategic Action plan *(for a certain time period, for instance, 3-year, 4-year, 5-year, etc.)*
- Implementation plan of action plan
- Financial Plan
- Information Technology and management information systems
- Marketing and communications
- Monitoring and evaluation
- Relevant Annexures *(including tables, charts, maps, etc.)*

International Business Plan of WSS Utility
International business plan of a WSS utility may include the following main items:

- Introduction of the water utility company and its functions
- Its track record
- Challenges that it is facing
- Customer centered business plan structure
- Summarized plan
  - Highly reliable
  - Emphasis on quality
  - Environmental sustainability
  - Responsiveness to customers
  - Business sustainability
  - Right culture

- Conclusion

Understanding the Components

The components of a business plan revolves around the following main questions:

1. Where are we now?
2. Where want to be?
3. What needs to be done to be where we want to be?
4. How to know whether we have reached the desired place or not?

First question is answered by performing the:

- PESTLE analysis;
- SWOT analysis;
- TOWS analysis; and
- KPI assessment

Second question is addressed by identifying:

- Mission;
- Vision statement;
- Objectives; and
- Strategies of the business plan.

Third question is answered through preparation of:

- Action Plan;
- Financial plan;
- Monitoring and evaluation; and
- Benchmarking

Fourth question is answered through assessment of current KPIs against KPIs once the business plan is implemented.

Each of the aforementioned elements are discussed below.

Vision: A vision statement describes where a company sees itself in the future *(in the long run)* or what the company wants to become

Mission: Mission statement establishes what the company is all about.

Objectives: Objectives are the quantified version of the vision and mission statements. "How much" of "what" will be accomplished by "When" is answered by the objective statements.

Strategies: Strategies refer to the initiatives taken to achieve the objectives.

Action Plan: Action planning involves planning each task with timeline and responsibilities

Key Performance Indicator (KPI): KPI refers to a performance measure of key areas of an entity.

Usage of objectives, strategy and KPIs exemplified:

Objective	**Strategy**	**Action Plan**				**KPIs**
		Details	**Responsible Official**	**Start**	**End**	
Metering up to 20%	New Metering Program	Awareness Companign	Dy Director Admin	Jan-17	Jan-18	Metering Level
		Procurement of Meters for consumers	Dy Director Procurement	Jan-17	Jun-17	
		Installation of Meters	Dy Director O&M	Jun-17	Dec-17	

Examples of vision/mission statements of business plans:

International WSS Utilities:
Singapore's National Water Agency
Vision: Water for All: Conserve, Value and Enjoy
Mission: To ensure an efficient, adequate & sustainable supply of water

Yokohama Water Agency
Vision: To be a leading company on water solution in Japan
Mission: To provide better quality service of water supply and sewerage to the world society
WASA Lahore:
Vision: WASA Lahore to be quality service providing utility, exceeding consumers' expectations through dedicated employees committed to excellence.

Mission: WASA Lahore would contribute towards making Lahore cleaner and environment friendly.

- Offering quality consumer services in the field of water supply and sewerage.
- Ensuring cost effective measures in Development works and operation and maintenance.
- Adhering to professional ethics and zero tolerance for corruption.
- Revenue generation at least sufficient to meet with the non-development expenditure and to make the system self-sustainable.

WASA Faisalabad:

Vision: To be an extraordinary service provider for the citizens of Faisalabad and thereafter to the center of excellence in water sector of the company.

Mission: To make our customers feel welcome, appreciated, and worthy of our best efforts in everything we do for providing water supply, sewerage and drainage services.

B-19: GROUP EXERCISE

GROUPS FORMATION

- **Six (6) Groups will be formed.**
- **Each Group will represent their respective Utility**

REQUIRED:

Each Group will LIST DOWN AND PRESENT at least 20 Strategies extracted from the Vision and Mission of your WSS Utility in following category:

1. Customers Satisfaction
2. Service Area
3. Work Force
4. Water Service
5. Sewerage & Drainage Service
6. Financial Sustainability
7. Metering
8. Quality of Service
9. Assets
10. Affordability of Service

(Time Available: 20 minutes)

SWOT Analysis

SWOT analysis helps the WSS utility in making the internal assessment including evaluation of strengths, weaknesses, opportunities and threats faced by a WSS utility.

Strengths: Answers the following questions:

- What the utility company do exceptionally well?
- What advantages does the utility company have?
- What valuable assets and resources does the utility company have?
- What do the utility company's customers identify as the strengths of the utility company?

Weaknesses: Answers the following questions:

- What could the utility company do better?
- What is the utility company criticized by or receive complaints about?
- Where are the utility vulnerable?

Opportunities: Answers the following questions:

- What opportunities have the utility known but has not addressed?
- Are there any emerging trends on which the utility company can capitalize?

Threats: Answers the following questions:

- Are the weaknesses likely to make the company critically vulnerable?
- What external roadblocks exist which might hamper the utility's progress?
- Is there any significant change coming in the water sector?

Advantages of SWOT Analysis:

- Identify Strengths
- Address weaknesses
- Deter threats
- Capitalize on opportunities

Limitations of SWOT Analysis:

- Doesn't priorities issues
- Doesn't provide solutions or offer alternative decisions
- Can generate too many ideas but not help you choose which one is best
- Can produce a lot of information, but not all of it is useful.

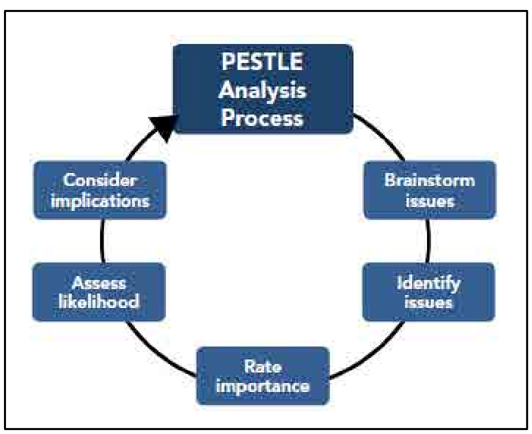
Format of SWOT Analysis

INTERNAL FACTORS					
	STRENGTHS (+)	IMPORTANCE		WEAKNESSES (–)	IMPORTANCE
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
7			7		
8			8		
9			9		
10			10		

EXTERNAL FACTORS					
	OPPORTUNITIES (+)	IMPORTANCE		THREATS (–)	IMPORTANCE
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
7			7		
8			8		
9			9		
10			10		

PESTLE Analysis

PESTLE analysis helps the WSS utility in making its external assessment including evaluation of political, economic, social, technological, legal and environmental factors surrounding the WSS utility.



<u>Advantages of PESTLE:</u>

- Identify external factors that are outside the control of your WSS utility

- These factors will have some level of impact on yours WSS operations

Limitations of PESTLE:

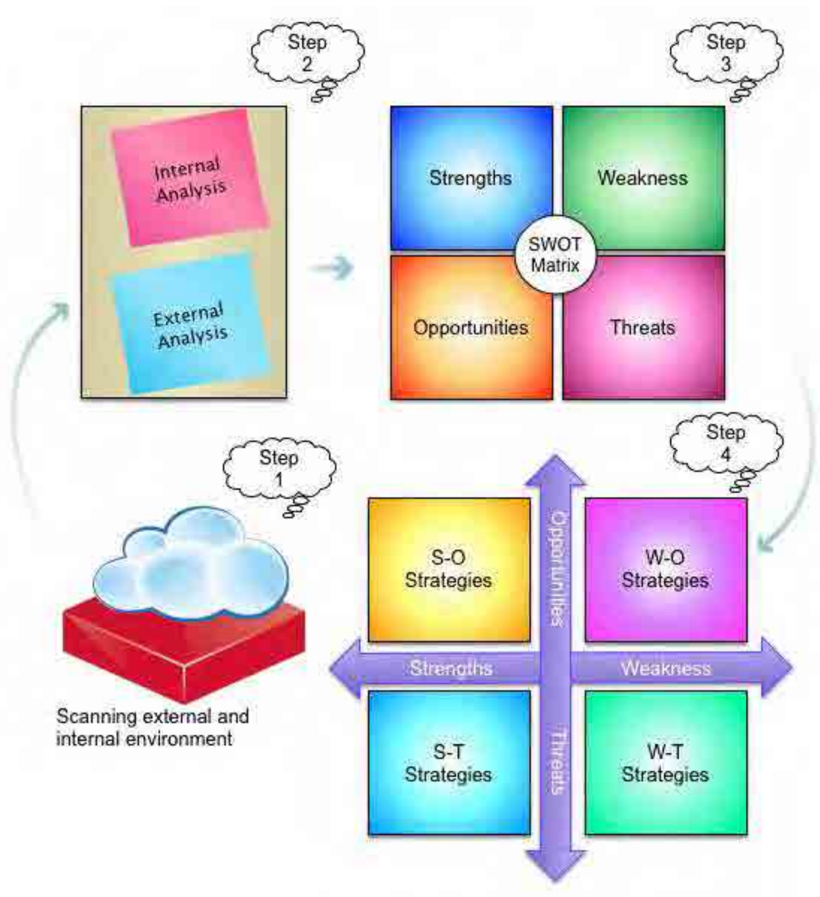
- Only Identify External factors that affects the Utility.
- Useful for new product launch or service, entering new region.

Format of PESTLE Analysis:

Factors	Importance	Impact Level	Time-frame
Political			
Economic			
Social			
TECHNOLOGICAL			
LEGAL			
Environmental			

TOWS Analysis

TOWS Analysis assesses the internal factors against the external factors in a grid as shown here:



Source: http://www.entrepreneurshipinabox.com/763/swot-analysis-4-steps/

<u>Advantages of TOWS analysis:</u>

- Identify Strengths, Address weaknesses, Deter threats and Capitalize on opportunities
- Identify S-O, W-O, S-T and W-T Strategies

<u>Limitations of TOWS analysis:</u>

- Doesn’t priorities issues
- Doesn't provide solutions or offer alternative decisions
- Can generate too many ideas but not help you choose which one is best
- Can produce a lot of information, but not all of it is useful.

Example of TOWS Analysis of WSS utility

Internal Factors / External Factors	Strengths (S)	Weaknesses (W)
	S1. Adaptation water scarcity. **S2.**The NWC and PWA. **S3.** The water law of 2002 **S4.**The awareness on water scarcity. **S5.** The existence of NGOs **S6.** The challenge of providing 150 l/cap/day for domestic users.	**W1.** Low water availability. **W2.** Insufficient and inefficient water services **W3.** The fragmented of institutional status. **W4.** Low cost recovery. **W5.** Insufficient. Awareness. **W6.** Lack of community participation.
Opportunities (O) **O1.** Potential water management alternatives and technologies. **O2.** Donor community. **O3.** Potential pricing systems that ensures cost recovery. **O4.** Palestinian water rights **O5.** The existence of community societies. **O6.** Research in water management. **O7.** Well qualified professionals.	**strengths and opportunities (SO)** **1.** Using S1, S 4 to benefit from O1, O2, O4, O6 to introduce new technologies for water saving. **2.** Establish regulations using S3 to support point 1 and to improve the pricing system O3. **3.** Activate NWC S2 in order to acquire water rights O4.	**weaknesses and opportunities (WO)** **1.** Using O1, O2, O4 to overcome W1, W2 by introducing emerging new technologies. **2.** Using O3 to alleviate W4 by introducing a new pricing system. **3.** Using O5 to overcome W6. 4. Using O7 to overcome W3 and W5.
Threats (T) **T1.** The Israeli control over the water ,resources. **T2.** There is no clear agreement regarding water allocation. **T3.** Pollution of the water resources. **T4.** Population growth.	**strengths and threats (ST)** **1.** Using S2 to overcome T1 and T2 by making use NWC to help in the negotiations with regard to the water issues. **2.** S3 can be used to overcome T3 by applying and enforcing the laws regarding pollution.	**weaknesses and threats (WT)** **1**. The threats T1, T2 regarding Israeli control over water can only be overcome through negotiations and pushing the world community to support this issue.

B-110: GROUP EXERCISE

GROUPS FORMATION

- **Six (6) Groups will be formed.**
- **Each Group will represent their respective Utility**

REQUIRED:
Each Group will conduct TOWS Analysis of your WSS Utility by:

1. List down at least 5 points in Opportunities, Threats, Strengths and Weaknesses,
2. Create strategies for SO, ST, WO and WT (10 Minutes)
3. Present it to other group (5 Minutes)
4. Q&A session (5 Minutes)

(Time Available: 30 minutes)

Benchmarking:
"Benchmarking is a tool for performance improvement through systematic search and adaptation of leading practices"[1]

Currently, around **160** benchmarking initiatives associated with about **700** Water and Sanitation Utilities.

Benchmarking Methodology:

Following are the preferable steps for benchmarking by a WSS utility (benchmarking activities).

1. Organize a Benchmarking Team
2. Identify Objectives
3. Select Benchmarking Methodology *(type)*
4. Collect Data
5. Apply Data Verification Procedure
6. Perform Data Analysis
7. Conduct Sensitivity Tests
8. Develop Strategy for Improve Performance

1. ***Benchmarking team*** WSS utility is required to establish a benchmarking team led by a focal person for the purpose of benchmarking and reporting. A team from within WSS utility company, i.e., staff members, usually constitute the team for assistance. Focal person is reportable to the Managing Director of the utility company. He shall develop an action plan for a certain period with the assistance of his team and hall get it approved by the Managing Director. He shall establish a mechanism of coordination with stakeholders. He shall also establish a robust filing system to track all record when required.

2. ***Identification of Objectives*** This step helps in developing a system of resource planning and setting up the organizational arrangement supported by responsibilities and resource to plan for the resources and phase extension of services. Objectives also include the target of improvement in service delivery.

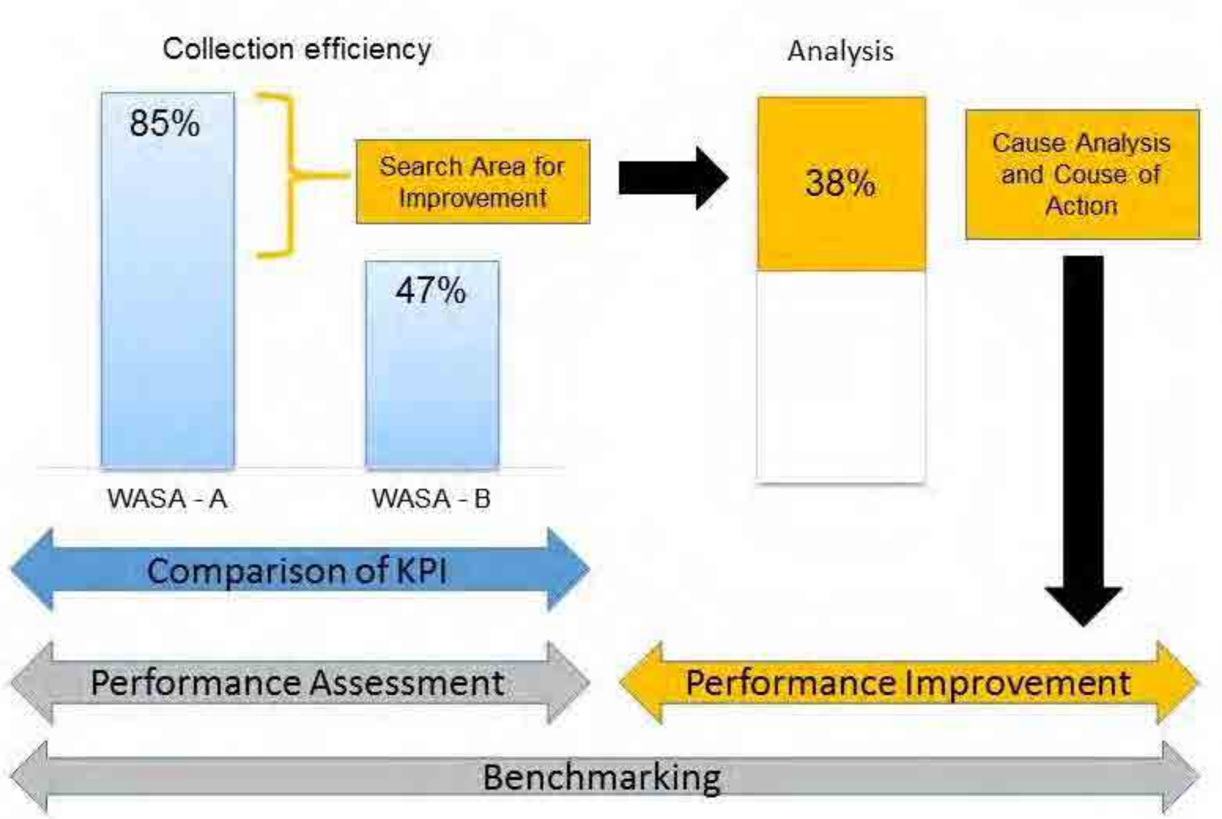
[1] *Source : Benchmarking Water Services – Guiding Water Utilities to Excellence by International Water Associations and American Water Works Associations*

3. ***Selection of Benchmarking methodology*** One of the types of benchmarking is required to selected in this step. The two types are.

- *Metric Benchmarking* – Involves numerical measurement of performance levels, comparison with other WSS utilities and identification of areas for improvement

- *Process Benchmarking* – Involves identification of key processes and learning of best practices

Pictorial representation of comparison between the two is given below.



B-111: INDIVIDUAL ACTIVITY

Tick (√) the type of Benchmarking from the following:

(10 Minutes)

Sr No.	Benchmarking	Metric	Process
1	Water Service Coverage (%)		
2	Arrear Recovery Strategy		
3	Energy Management Plan		
4	Water Production (lpc)		
5	Pipe Breakage (km)		
6	Revenue Collection Mechanism		
7	Metering (%)		
8	Assets Management Process		
9	WSS Staff per 1000 connections		
10	Operating Ratio		

4. ***Data Collection*** This step relates to the collection of data for benchmarking purpose, it is required to be identified that what kind of data is required to be collected. In this respect it must be clarified, that the data collection for the purpose of computing KPI must be done. In this regard, performance indicators are given by different international and national organizations that can be used as reference. Some of these are discussed below.

   International Water Associations – IWA: Gives 6 performance indicators with 47 sub-indicators.

   Economic Regulator of Water Sector in England and Wales – OFWAT: Gives 4 performance indicators with 19 sub-indicators.

   International Benchmarking Network for Water and Sanitation Utilities – IBNET: Gives 11 performance indicators with 91 sub-indicators.

   Planning and Development Department, Government of Punjab

   - Water Supply Coverage (%)
   - Sewerage Coverage (%)
   - Duration of Water Supply (Hrs.)
   - Water Production (lpcd)
   - Waste Water Collected (m^3 per day)
   - Non-Revenue Water (%)
   - Water Quality (at production and Consumer end)
   - Assets Condition above average (% as per survey)
   - Power Factor of Assets above 95% (% of total assets)
   - Complaint resolved (% of each town)
   - Revenue Collection Efficiency (%)
   - Water Supply Pressure (bar)
   - Operational Assets Management System (%)

   Discussion on some of the KPIs is given below.

   - *Water Supply Coverage (%):"Population with access to water services (either with direct service connection or within reach of a public water point) as a percentage of the total population under utility's nominal responsibility"*

     Unit: *Percentage*

     Formula:

$$\frac{Population\ served\ with\ water\ supply}{Total\ population\ in\ WSS\ Service\ Area - Water} \times 100$$

- *Sewerage Coverage (%):"Population with sewerage services (direct service connections) as a percentage of the total population under utility's notional responsibility"*

  Unit: *Percentage*

  Formula:

$$\frac{Population\ served\ with\ sewerage\ services}{Total\ population\ in\ WSS\ Service\ Area\ - Swerge} \times 100$$

Note: Population served with WSS utilities include residential houses, hotels, hospitals, commercial markets & shops, industries, Government Office & others

Detailed explanation to the formulae is given below:

Population served with water supply = ((A+B)×C)+D+E+(G-F)

Ref.		Particular
5.4(d)	A	Water residential connections – metered
5.4(g)	B	Water residential connections - unmetered
2.4	C	Household size
2.5	D	Population served – public water points
2.7	E	Population served – direct water supply
2.6	F	Population without water and Wastewater services
2.3(a)	G	Total population in W & S operator area of responsibility – water supply

Population served with water supply = ((A×B)+C+(E-D)

Ref.		Particular
6.5(a)	A	Sewer residential connections
2.4	B	Household size
2.8	C	Population served – Wastewater services
2.6	D	Population without water and Wastewater services
2.3(b)	E	Total population in W & S operator area of responsibility – Wastewater

- *Water Production (lpcd):* "*Total water supplied to the distribution system (including purchased water, if any) expressed by population served per day*"*

Unit: Liters per Capita per Day (lpcd)

Formula:

$$\frac{\text{Total Water Production (Litres)}}{\text{Population served with water supply} \times \text{Nos. of Days}}$$

Total production is measured through bulk flow meters and currently bulk flow meters are not installed at most places. In addition, some meters installed are not functional.

Detailed explanation to the formula for water production is given below:

Population served with water supply = ((A+B)×C)+D+E+(G-F)

$$\text{Total Water Production} = \sum_{a=1}^{m}(H_a - I_a) + \sum_{b=1}^{n} J_b + \sum_{c=1}^{o} K_c$$

Ref.		Particular
5.4(d)	A	Water residential connections – metered
5.4(g)	B	Water residential connections - unmetered
2.4	C	Household size
2.5	D	Population served – public water points
2.7	E	Population served – direct water supply
2.6	F	Population without water and Wastewater services
2.3(a)	G	Total population in W & S operator area of responsibility – water supply
4.7	H	Water meter reading (closing)
4.6	I	Water meter reading (opening)
4.10	J	Volume of water produced with bulk meter
4.11	K	Volume of water produced
	m	Total no. of tubewells with operating bulk meters
	n	Total no. of tubewells without operating bulk meters
	o	Total no. of surface water sources

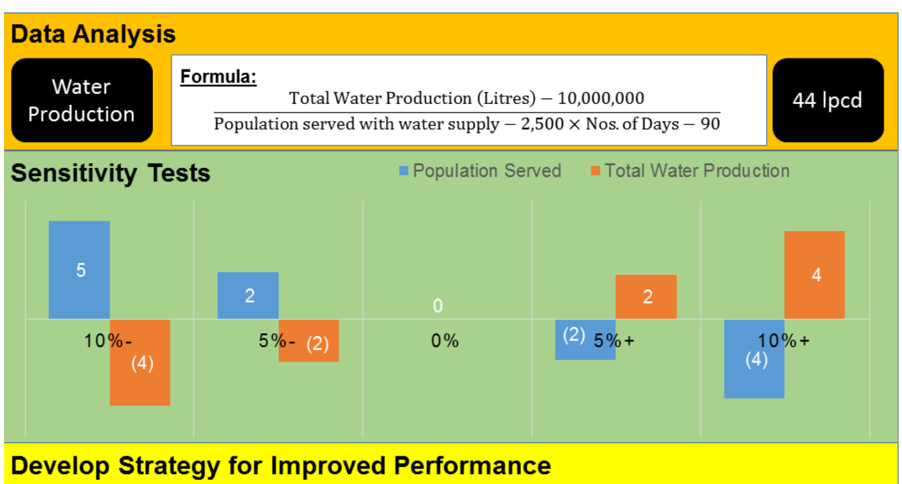
Source : http://www.ib-net.org/en/texts.php?folder_id=101&mat_id=82&L=1&S=2&ss=1

5. ***Data Verification*** Confidence on the data is obtained by assigning the BAND to each category of data collected. Since data is derived from various sources, hence, the extent of reliability on each data category would vary. Hence, each data category must be

allotted a BAND to attribute the reliance level of each data. The Confidence BAND legend is given below:

Band	***Description***
A	***Based on reliable records, procedures, investigations or analyses, that are properly documented and recognized as the best available***
B	***Generally as in band A, but with minor shortcomings, e.g. some documentation is missing, the assessment is old, or some reliance on unconfirmed reports or extrapolation is made***
C	***Extrapolation from a limited sample for which Band A or B information is available***
D	***Based on the best estimates of utility staff without measurement or documented evidence***

6. ***Data Analysis, Sensitivity Analysis and strategy formulation*** Once the data is collected and verified, it is analyzed by applying the same in the respective formulae and the sensitivity tests have to be performed followed by development of strategy for improvement of performance. Inter-relationship between data analysis, sensitivity testing and strategy formulation is clarified through the pictorial representation below.



B-112: GROUP EXERCISE

<u>GROUPS FORMATION</u>

Six (6) Groups will be formed.

Each Group will represent their respective Utility

<u>REQUIRED:</u>

Prepare the **<u>“Action Plan”</u>** to ensure smooth start and end of Benchmarking activities on continuous basis to:

1. Identify the staff currently involved with designation?
2. Identify the understanding of the staff members involved?
3. Any other staff member may also be involved?
4. Current Data Collection activities with proposed improvement?

Each group will present for 5 minutes

(Time Available: 30 minutes)

<u>FORMAT</u>

Objective	Strategy	Action Plan				KPIs
		Details	Responsible Official	Start	End	

THE END

Phnom Penh Water Supply Authority (PPWSA)

Source:

https://en.wikipedia.org/wiki/Phnom_Penh_Water_Supply_Authority#Increased_access

>https://www.youtube.com/watch?v=R6rL17bZWpk&feature=youtu.be

>http://www.jica.go.jp/cambodia/english/office/others/video_library.html

Relevance of case study

The Phnom Penh Water Supply Authority (PPWSA) is the municipal water utility that serves Cambodia's capital Phnom Penh and surrounding areas. In 1992 it provided low-quality piped water at very low pressure (0.2 bars) for only 10 hours per day to only 20% of the city's residents. Non Revenue Water was extremely high at 72% due to illegal connections, manipulation of bills and physical leakage. Tariffs were extremely low, there was no metering and less than half of the amounts billed were collected. Staff were underpaid and demoralized. The following actual reform would be a good reference for WASAs.

Outline of PPWSA reform

The utility underwent a dramatic turnaround with a strong leadership of EK Sonn Chan, top management—staffs engaged in corrupt activities were fired, bill payment was enforced, illegal connections were regularized, metering was introduced and the utility gained autonomy from the municipality in financial and personnel matters. In the next fourteen years, the customer base multiplied by nine reaching over 90% of residents, service quality improved from intermittent to continuous supply of safe drinking water at good pressure of 2 bars, and non-revenue water was cut to only 6%. Tariffs were increased and the utility went from being bankrupt to making a modest profit. It now has motivated, well-paid staff. According to one observer, in 2012 its "public image is excellent". The key to its success laid in "leadership, professionalism, integrity (and) commitment" as well as "community participation and information sharing (...), good governance, transparency and accountability". Significant financial support from external donors, initially through grants and then through soft loans, also was essential in making the turnaround possible. PPWSA's achievements were recognized through international awards, including the Ramon Magsaysay Award for Government Service in 2006 and the Stockholm Industry Water Award in 2010.

Indicators/ year	Year 1993	Year 1999	Year 2003	Year 2009
Phnom Penh population	680,000	880,000	1,030,000	1,440,000
Water supply coverage	25%	62%	82%	90%
Connections	26,881	60,482	105,777	191,092
Water supply capacity (m3/day)	65,000	120,000	235,000	300,000
Water supply pipe length (km)	288	455	921	1,500
Water quality standards	unknown	unknown	WHO guideline	WHO guideline
Water supply pipe net work pressure	0.2	2.0	2.5	2.5
Water supply duration a day (hours/ day)	10	24	24	24
Non Revenue Water (NRW)	72.0%	48.5%	17.1%	5.9%
Staff per 1, 000 water supply connections	22.0	7.8	3.9	3.2
Water supply charge collection rate	48.0%	98.9%	99.8%	99.9%

Source: Miracle of Phnom Penh, March 2015, Kuwajima/ Suzuki, JICA

Increased access

The number of customers increased more than fivefold, leading to an increase in the served population from 25% (1993) to 92% (2010). The capacity of the distribution network was increased from 65,000 m^3/day to 320,000 m^3/day in 2012. Water vendors which charged up to five times more for water than what consumers pay to the utility now have all but disappeared from the PPWSA service area.

Improved water quality

Drinking water quality has improved and the director says he is drinking the tap water without boiling and challenged his customers: “If you get stomachache after drinking the tap water, I will pay you compensation”.

Reaching the poorest

PPWSA established a revolving fund to finance domestic connections to help the poorest connect to the network. The utility serves more than 27,000 families (14% of all customers) in more than 123 urban poor communities at subsidized tariffs and connection fees, which can be paid in installments. Poor households are entitled to receive subsidies of 30%, 50%, 70% or 100% of the connection fee, depending upon their financial conditions. These conditions are jointly evaluated by a committee of the utility and local communities, with results being published.

Engaging with communities

The utility developed a close relationship with its customers. For example, it provided incentives to members of the public who reported illegal connections. This, together with the fight against small-scale corruption and improvements in service quality, helped to gain public acceptance for tariff increases.

Improved finances

Meters were installed for all water connections, the billing system was computerized and non-payment penalties were introduced. As a result, collection efficiency for residential customers increased from 48% to 99.9%. Tariffs were increased in 1994, 1997 and 2001, every time with the required approval of the Prime Minister. In 1995 the utility began to make small profits, which increased substantially after 2000. Operating revenue for the 2008 financial year was $21.9 million, out of which it made a profit of $7.3 million on which it paid corporate income tax. In 1996 the utility had proposed a three-step tariff increase over seven years to reach the government's policy goal of full cost recovery. The third step proved to be unnecessary given the substantial efficiency improvements achieved by PPWSA.

Affordability

In 2013 the lowest block of the residential water tariff up to a consumption of $7m^3$ per month was 550 Cambodia riel ($0.13) per m^3, followed by a second block up to $15m^3$ at 770 Riel ($0.19) per m^3. A typical residential water bill is US$ 3-5 per month, around 1 percent of the average income.

Improved efficiency

Non-revenue water, an indicator of operational efficiency, was reduced from 72% in 1996 to 6% in 2010. The number of staff per 1,000 connections was reduced from 22 to 3 in 2010, indicating substantially increased labor productivity. Since the number of connections increased more than fivefold, the actual number of staff remained about the same, while they were much more productively employed.

Motivated and qualified staff

Staff salaries increased substantially during the reform process. For example, a staff member at a managerial position who was paid $20 in 1993 received $200 in 2008. Profits are shared with employees. The utility has created a retirement system for its employees which are the first of its kind in Cambodia. It evaluates its employees four times a year and can provide financial incentives as well as disciplinary actions such as delays in salary increases or even salary deductions. The utility also provides substantial training, followed by exams.

External cooperation

External cooperation played a major role in bringing about the turnaround of the Phnom Penh water utility. Japan ($85 million in grants), France ($21 million in grants and $14 million in loans), the World Bank ($29 million in loans), the Asian Development Bank ($13 million in loans) and UNEP provided financial and technical assistance to PPWSA. The external financial assistance totaled approximately $165 million between 1993 and 2009.

COMMUNICATION PLAN

Overview of Business Development Plan

Business planning is critical in the achievement of business objectives and hitting targets. This Business Planning course provides a thorough grounding in how to create measure and implement a business plan. Course Participants will discuss on the key Service Delivery GAPs. The course will provide them with the skills and insights to develop strategy and resolve organizational issues; this course covers the topics of GAP analysis in service delivery along with strategies for service delivery improvement and formulation of business plan. The Course Participants will capitalize on the learned skills to operate more effectively in their respective utility.

Competitive Advantage of Course

- Business Planning is the first of its kind course for water sector professionals in Pakistan. It combines the best practices of technical and non-technical fields to help the water sector managers become self-sufficient in making plans for their respective utilities.
- This course will have the paradigms of Asset Management, Finance, Human Resource and Engineering to help the managers make a comprehensive business plans covering maximum aspects of water sector utilities.

Learning Outcomes

- Understand and diagnose the key service delivery gaps including water supply, sewerage services, human resource and financial management based on data analysis.
- Set the Key Performance Indicators (KPI)
- Formulate Performance Improvement Plan (PIP) for service delivery
- Conduct work force modeling and formulate human resource improvement plan
- Review revenue management practices along with revenue collection challenges and formulate financial management improvement plan.
- Prepare a business plan, linked with approved IDAMP framework, to address service delivery gaps.

Public Communication Plan

This Public Communications plan has been prepared by the Urban Unit with an objective to develop and implement a communication strategy for water and sewerage issues while ensuring that we, along with our program partners, spearhead a relentless awareness campaign. With this document in hand, we are looking forward to a new era of vibrant communication, closer interactions and improved linkages with all possible stakeholders for the benefit of people to be touched by this project.

The proposed vigorous campaigns, fast track dissemination of information as guided by this plan, the Business Plan we have presented, will be strengthened and the residents of targeted cities will begin to reap the benefits that the communication document will foretell for the communities.

Significance of Communication Plan

There has been a dire need of developing an overarching Public Communication Strategy looking after the communications objective of the cities' improvement plan. The current disparate approaches in using the communication tools have been unable to deliver the desired results thus strengthening the need to adopt proper professional guidelines and coordination.

This integrated and comprehensive Public Communication Plan has an overriding objective of developing a harmonized document in order to put in place a comprehensive and accurate referral document providing basic and very essential guidelines which are globally accredited vital for realizing public communication objective of any urban development project. Without a focused and well-executed public communication plan, we cannot effectively relate to its multiplicity of stakeholders, let alone deliver the tedious task of realizing an integrated Water & Sewerage management plan for our cities.

This document spells out guidelines and key communication specifics, along with the actual activities that will be expected to define the project's annual calendar. The routine communication activities have been brought on board to cover the full array of possibilities for public engagement and participation through print and electronic media - from creative use and engagement with newspapers, radio and television all the way to the development and publication of project documents as a basis for its constant and long-term record.

How to Make an Effective Communication Strategy

Communication is generally considered an integral component for making the management realize its true objectives. So, it requires to be planned and budgeted for, in order to:

- Ensure the most efficient and effective utilization of resources through a process of prioritization and rationalization;
- Provide practice guidelines and clear direction for daily activities;
- Identify the drivers of change as well as the best means to engage with them
- Ensure predictability and continuity, while enabling a continuous review of current organizational activities and indicative milestones against which we will measure success.

An effective Communication Strategy must clearly establish the following elements:

Policy Objectives

These are key to the success of a communication strategy. The main point is that the objectives should enable the communications policy/strategy to be organizationally driven rather than communication driven.

Audiences & their Profiles

It is vital to identify and profile the different target audiences and also determine proper strategies to engage with different targets and profiles.

Key Messages

Strategic targeting and consistency are essential to construct the awareness messages on behalf of the organization. We have to create a comprehensive case covering all the key messages, and emphasize the different elements of the case for different audiences.

Channels, Tools and Activities

We will identify the various channels to be used in the communication process and also need to elaborate these as well as key activities that can deliver the desired results.

Communication's Budget

To incorporate the communications cost is a must. A good strategy always factors in a budget as a key aspect of the overall management of the strategy.

Monitoring & Evaluation

The periodical assessment of the effectiveness and impacts of the Communication Strategy with both internal and external audiences, should be carried out. The results of the evaluation will be discussed and used to review and amend the strategy, if required.

Key Audiences of the Plan

WASAs related audiences and stakeholders include both public and private sector as well as Civil Society Organizations (CSOs), including Non-Governmental Organizations (NGOs) working for the sector, other cities' administrations, development partners, stakeholders and advocacy groups, relevant training institutions, Members of Parliament (cities specific), WSS professionals, environmentalists, etc. and various environmental groups.

These different audiences can be divided into three categories:

- Internal audiences
- External audiences
- Media

All channels of communication and messages have to be tailored accordingly to suit each of these.

Communication Plan for WASAs

The proposed Communication strategy has to promote behavior change while using clear and appropriate messages. The objectives of the strategy are given below.

Overall Objectives of the Strategy

1. To increase awareness, improve knowledge standards and build support for key stakeholders
2. To promote positive water and sanitation management practices among all key stakeholders

3. To create demand for use of the improved services

The first objective is a short-term objective that focuses on improved communication and needs to be accomplished in limited times span. The second one is a long-term behavior change communication objective targeting sustainable changes in specific behaviors.

Specific Approaches

The overall objectives will be achieved through the use of the following specific strategies:

1. **Internal communication** to increase knowledge and build support
2. **Public participation mechanisms** in order to provide the institutions involved much needed platform to engage opinion leaders, implementation partners as well as the general public
3. A phase-wise branded **multi-media communication program** to increase knowledge of communication tools, and to motivate consumers to adopt positive WSS practices
4. **Media advocacy** to promote accurate and analytical coverage of communication plan and WSS issues in target areas
5. **Capacity building** of the institutions involved in order to implement the Communication Strategy and longer-term behavior change programs

Internal Communication

Internal communication within involved institutions will build staff support for ne interventions by increasing knowledge about these, building a strong case for why interventions are needed, and demonstrating the benefits for both institutions and communities. The communication should be led from top and its implementation can be made possible using the following methods.

- Reinforcing existing formal communication structures with a special reform 'team briefing system' to hel p line management communicate to their staff. This system would aid build line management commitment to the messages and, if properly implemented, ensure that key messages are cascaded down through the hierarchy of the organizations.
- Interaction facilitation with staff to address sensitive issues regarding job, organizational changes etc.
- Special events arrangement for staff to inform, celebrate and motivate them about former communication interventions as well as the launch of new initiatives. The level of communication will be significantly higher than normal routine. These events will be highlighting the importance of the issues faced.
- A quarterly internal newsletter production
- Star of the Month to be announced and celebrated
- Frequent internal meetings
- Briefing documents
- Consultations sessions
- Use of circular communication process with an emphasis on feedback

- Management debriefing meetings once a month
- Celebrate major accomplishments so that all employees are reenergized and empowered with a new sense of direction and fulfillment forged
- Ensure wide spread availability of information through notices, e-mail communication; newsletter, website and all other channels for purposes of general information
- Provide proper orientation to all new/ incoming staff
- Publish materials including books (if required), reports and various IEC materials of interest to the WASAs and their various stakeholders
- Timely and clear communication to staff

Tools	Audience	Outcome Indicators	Partners	Budget
Quarterly newsletter	Staff members	Staff more informed than usual on policy matters, interventions etc.	NA	
Frequent meetings	Staff and administration	Smooth information flow/trust building among employees	NA	
Briefing documents	Staff	Improved knowledge about organization	NA	
Celebrate major accomplishments	Staff	Reenergized and empowered staff with a new sense of direction and fulfillment	NA	
Publish materials including books (if required), reports and various IEC materials	Staff	Informed employees	NA	
Star of the Month Celebrations	Staff	Raised level of confidence along with spirit to perform better	NA	
Notice boards, office circulars	Staff & management	In time information of events going around	NA	
Intranet	Staff and management	Data shared for effective and timely management of assigned tasks	NA	

Establishing Public Participation Mechanisms

- Opinion leaders, as influencers within their stakeholder communities, will play vital role while being cost-effective tool of interpersonal communication. It will reinforce the messages already sent out through mass media channels.
- Sharing of information and consultation forums will create the opportunity for opinion leaders to become informed partners as well as disseminate the information and receive feedback from stakeholder groups at later stages.

- Establishing WSS forumsas vehicles for ongoing twoway communication with consumer representatives and sector management will be an essential component for addressing and solving WSS issues. In long-term plan, we can establish WSS forums down to the city and even constituency levels for improved feedback. Such forums will be culminating in high profile Forums/Events held to coincide with the annual World Water Day or related occasions.
- Corner meetings with community representatives
- Community-led public participation activities like small gatherings, mini seminars and public speech forums

Media-Communication Program

- Deliver communication from a branded platform (corporate identity) to maintain coherence across different communication activities
- A 'Need to Know' basis information flow through media
- Active engagement with mainstream media in cities, in order to reach general public for continuous understanding of the role and mandate of WASAs, their objectives, functions, challenges and constraints that stand in the way of realizing the ultimate objective.
- Proactive promotion of positive information and campaigns in media
- Develop and maintain good relationships with media
- Participate in radio and TV talk shows
- Organize for press conferences to profile WASAs activities
- Make relevant information timely and newsworthy at all times
- Arrange to write quality write-ups for leading newspapers about reforms in WASAs
- Thematic media campaigns for information of communities
- A multi-media campaign delivered utilizing both paid-for advertisements, earned media and interpersonal channels
- Advertorials and adverts in the print media
- TV and Radio infomercials
- Documentary
- Information materials – posters, brochures
- News and feature articles in both print and electronic media

Tools	Audience	Outcome Indicators	Partners	Budget
Series of print advertorials and adverts in the print media	The general public	Increased level of awareness within short time	Media organizations	
TV, Radio and Cable Infomercials	The general public	Enhance the quality of knowledge on various initiatives	NGOs, CSOs and other departments of government	

Documentaries	The general public	Enhance the quality of knowledge on various initiatives	NGOs, CSOs and other departments of government	
Information material – posters, brochures, flyers, leaflets, news bulletins	The general public	Increased number of community members supporting the initiatives	NGOs, CSOs and other departments of government	
News and features in print media	The general public	Informed masses and aware communities	Newspapers, journals, magazines etc.	
News, packages, interviews, SOTs on various local and national TV channels	The general public	Informed masses and aware communities	Local and national TV channels	
Radio spots, programs and news on FMs	The general public	Informed masses and aware communities	Local FMs	
Cable ads	The general public	Informed masses and aware communities	Local cable networks	
Tools	**Audience**	**Outcome Indicators**	**Partners**	**Budget**
Information and Communication (IEC) material	Key decision makers, private sector, advocacy groups, media	Increased number of leaders and decision makers integrating the relevant messages in their own organizations, external support	Stakeholders like government departments, relevant organizations in field	
Quarterly progress reports/ Newsletter	Key decision makers, private sector, advocacy groups, media	Increased number of leaders and decision makers integrating the relevant messages in their own organizations, external support, informed communities	Stakeholders like government departments, relevant organizations in field	
Brochures/ periodicals on progress and challenges	Key decision makers, private sector, advocacy groups, media	Increased number of leaders and decision makers aware and conscious of work going on, external support, informed communities	Stakeholders like government departments, relevant organizations in field	
Fact sheets	Key decision makers, private sector, advocacy	Increased number of community members supporting the initiatives	NGOs, CSOs Stakeholders like government departments, relevant	

	groups, media		organizations in field	
Web posts	Key decision makers, private sector, advocacy groups, media, social media audience	Increased number of community members supporting the initiatives, hype on social media	Various social media platforms	
Establishment of local level consultation forums	Key decision makers, private sector, advocacy groups, media	Increased number of leaders and decision makers aware and conscious of work going on, external support, informed communities, feedback available	NGOs, CSOs Stakeholders like government departments, relevant organizations in field	

It is pertinent to note and remember that media houses operate under tight deadlines, hence the need for speed and promptness increases while dealing with them.

Media Advocacy

Media will be leveraged as a strategic partner using a proactive media relations program. Local and national media will also be used as one of the channels for communicating the initiatives/interventions to the public. Involvedinstitutions will proactively engage media organizations by providing them with tailor ed information and tools to facilitate accurate and analytical coverage.

- Leverage media as a strategic partner
- Build on positive coverage to build the right media content and treatment
- To influence the nature of coverage
- Media training workshops at the national and city levels will be designed to prepare beat reporters/journalists to cover WASA issues more analytically
- Implementation of advocacy approaches to build support among all WASAs in order to improve public service delivery in all cities
- Confidence building exercises in collaboration with involved partners/departments to magnify new projects and initiatives so that public is made a stakeholder directly.
- Tailored communication keeping in view the specific needs of each target group while focusing on benefits that will bring a positive change to their lives eventually benefitting the communities.
- Jumping onto all possible relevant activities held by other departments/NGOs etc. to add WASAs' own statement, point of view to catch any hype building opportunity

Tools	Audience	Outcome Indicators	Partners	Budget
Media Kits	Owners/ Executives of media houses	Increased knowledge on the initiatives and achievements among reporters and editors	**Media houses**	
Training workshops, editorial briefings and discussions	Editors of local and national media houses	Increased knowledge on the initiatives and achievements among reporters and editors	**Editors' Associations**	
Case studies, success stories, on new initiatives and interventions	Journalists in local and national media houses	Percentage increase in coverage of media	**Media houses**	
News items, TV and Radio programmes, feature articles etc.	Journalists in local and national media houses	Percentage increase in coverage of media	**Media houses**	

Tools for Sector Specific Communication

Tools	Audience	Outcome Indicators	Partners	Budget
Briefing materials	Opinion leaders on local and national level in influential organizations with wide audience reach	Discussions, mentions by opinion leaders on various forums	**Media, NGOs, CSOs**	
Seminars and workshops	City administration, civil society, religious leaders, opinion makers, relevant private sector organizations	**Increased knowledge among policy makers and decision makers**	**TMAs, CDGs, NGO s, CSOs and civil society**	
Organizational meetings	City administration and relevant organizational staff	Increased number of aware and informed staff and administration and motivated for action	**Stakeholders like government departments, relevant organizations in field**	
Articles in sector publications	Key decision makers, private sector, advocacy groups, media, City administration, civil society, religious leaders, opinion makers, relevant private sector organizations	Increased knowledge of various initiatives among policy and decision makers	**Key government and private relevant organizations**	
Quarterly	Key decision makers, private	Increased knowledge of	**Key government**	

progress Newsletters	sector, advocacy groups, media, social media audience	various initiatives among policy and decision makers	**and private relevant organizations**	

Branding and Identity

The strategic objective of branding will target strengthening WASAs public standing. As a key principle, underpinning WASAs' branding and corporate identity shall include:

- The agreed logo shall be promoted.
- The brand identity will be projected in all its documents, including, its various types of correspondence, PowerPoint presentations, and advertisements and /or any other form of publicity

Monitoring and Evaluation

Monitoring and Evaluation is always essential to objectively establish progress towards the achievement of set goals. It will also track the performance of the programme. The key aspects of the M&E framework will include:

• Monitoring of the implementation of the activities as they happen through process and outcome indicators

• Assessing the outcomes and the contribution of communication activities at regular intervals (e.g. baseline surveys to assess changes in knowledge, attitude, behaviors and practices)

• Adding results to the overall WASA information management system

A formal survey is proposed to be carried out to measure the effectiveness of the messages and engagement with stakeholders at various levels. The level of awareness, appreciation of the brand, assimilation of the message will be measured among target audiences. The results will determine whether the strategy is on course, any adjustments that may be required and resultant risks that need to be managed.

Media monitoring will be an integral part of the survey, to monitor local print and electronic media. The number of negative or positive mentions, amount of space, prominence of the item and the tone will also be measured.

WASAs can take the following measures to monitor the success and effectiveness of its communication programme:

(i) Close monitoring of media coverage in both print and electronic media
(ii) Stakeholder satisfaction and awareness survey, undertaken during every phase of implementation
(iii) Staff knowledge and satisfaction assessment
(iv) Range, quality and depth of communication products produced for different audience segments
(v) Delivery of measurable improvements in the quantity of communications delivered through the website and staff intranet

(vi) Increased brand recognition WASAs at local, national, regional and international level
(vii) Delivery of best value communication service, and
(viii) Stronger partnerships and networks established with different institutions other stakeholders and organized groups

Evaluation indicators:

- Number of clips appearing in the newspapers
- TV clips
- Number of appearances and or references in websites and blogs
- Tone of articles, size and prominence
- Number of stakeholder engagement meetings held
- Number of workshops held
- Number of participants

Conclusion

The matrix integrates all aspects of the strategy indicating the logical link between the audience, key message themes, methodology, channels and tools, expected outcomes and implementing partners. Key message themes are based on the objective for communication for each audience and the findings from the assessment. The strategy matches audiences with specific channels depending on the appropriateness of the channel to the specific audience. The approaches combine mass media, community-level activity and interpersonal communication - all linked to specific outcomes.

Participatory approach: Water supporters **May 04, 2016**

- **it can be also applied in reduction of arrears**

Yahaba municipality has conducted resident participatory approach to increase awareness of water supply works, to begin with:

1) **Questionnaires**
2) **Outreach (interviews with 1,000 residents)**
3) **Workshops with Water supporters**

Many consumers complained in the questionnaires and interviews:

1) **high tariff,**
2) **bad smell**
3) **not sweet**
4) **drinking water is from supermarket**

Yahaba municipality, declared: establishment of "Water Supporters" in a newspaper.

Yahaba municipality conducts monthly meeting with the Water Supporters, at first seven (7), currently twenty (20) with a fee.

The Water Supporters firstly requested for the tariff decrease, however, for service improvement, supply of safer/ sweeter water: non-cooperative actions, seeking individual interests in a short term, not considering public benefits in a long term: "social dilemma".

How to change their attitudes from "non- cooperative" to "cooperative" to solve the "social dilemma".

1) **Yahaba water works disclosed their current financial situation. It was very hard for Yahaba water works. However, otherwise, the water works was not able to obtain a reliance from Water Supporters.**
2) **Yahaba water works conducted a water purification plant visit by the Water supporters. The supporters were able to understand how to produce water to deliver to residents.**
3) **Blind Test: which is sweeter, tap water or bottled water from supermarket? Some people said the tap water is sweeter.**
4) **Workshop with Water supporters**
   - **Clarifying a part of facilities that would stop water supply if the facility is out of order.**
   - **Identifying a part of facilities that could be substituted by other ones.**
   - **Discussing they can use the facility not forever, but use for a certain period, e.g. ten (10) or twenty (20) years**
   - **Studying future design of water works: facility reduction with prospective decrease of population, or merge with other water works facility**
5) **The Water Supporters were surprised to see pipe internal photographs describing many stains, which Yahaba water works showed.**

6) **The Water Supporters requested for tariff increase.**

- **It is important to share knowledge of water supply/ sewerage, reliance and moral with residents to build a consensus.**
- **The participatory approach can be also applied in reduction of arrears**

It is necessary for WASA to provide information for consumers through web sites, brochures and others: WASA management issues, necessary revenues to sustain the water supply/ sewerage services. Especially it would be effective to have a dialogue with consumers of districts having many complaints of e.g. many water leakages/ suspensions. The following charts shows an example of Yahaba municipal water works, Iwate Prefecture in Japan, involving citizens: assigning “Water Supporters” from consumers, explaining its water works management issues to the Water Supporters, conducting a visit of the Supporters to its Water Purification Plant and workshops to discuss how to improve the management. The Supporters requested for Yahaba municipality to increase current tariff.

出典:岩手県矢巾町役場水道課/吉岡氏

図 3.12.2　住民参加による合意形成の事例

添付資料 3.47

2016 年秋期研修カリキュラム

Curriculum for Training in Fall 2016

Course	Module	Time (days)	Methodology (%)		Evaluation (points)				Passing marks
			Theory	Practical	Attendance	Participation	Assignments	Total	
O&M of Tube Well and Pump Facility	1. O&M of Water Distribution System	5	60	40	20	0	80	100	50
Leakage Detection	1. Basic knowledge of Leakage Prevention Work	1	100	-	30	50	20	100	50
	2. Leakage detection and repair at the site (OJT)	1	0	100					
	3. Install & operation of the equipment at the site (OJT)	1	-	100					
	Action Plan	1	-	100					
O&M of Sewer And Storm Water Drainage	1. Safety control and measure for sewerage and drainage	3	33	67	25	0	75	100	50
	2. Operation and maintenance of drainage system	2	36	64	25	0	75	100	50
	3. Operation and maintenance of sewer system	4	50	50	25	30	75	100	50
O&M for Electrical Equipment	1. Electrical Panel and Instrumentation Equipment	3	33	67	30	0	70	100	50
	2. Generators	3	33	67	30	0	70	100	50
	3. Supervisory Control and Data Acquisition (SCADA)	3	33	67	30	0	70	100	50
O&M for Mechanical Equipment	1. Centrifugal Pumps, Induction Motors and Valves	3	33	67	30	0	70	100	50

<table>
<tr><th rowspan="2">Course</th><th rowspan="2">Module</th><th rowspan="2">Time (days)</th><th colspan="2">Methodology (%)</th><th colspan="4">Evaluation (points)</th><th rowspan="2">Passing marks</th></tr>
<tr><th>Theory</th><th>Practical</th><th>Attendance</th><th>Participation</th><th>Assignments</th><th>Total</th></tr>
<tr><td rowspan="3"></td><td>2. Chlorination and Filtration System</td><td>2</td><td>33</td><td>67</td><td>30</td><td>0</td><td>70</td><td>1000</td><td>50</td></tr>
<tr><td>3. Water Meter Selection and Maintenance</td><td>2</td><td>33</td><td>67</td><td>30</td><td>0</td><td>70</td><td>100</td><td>50</td></tr>
<tr><td>4. Heavy Machines</td><td>3</td><td>20</td><td>80</td><td>30</td><td>0</td><td>70</td><td>100</td><td>50</td></tr>
<tr><td rowspan="6">Asset Management</td><td>1. Introduction of Asset Management</td><td>3</td><td>40</td><td>60</td><td rowspan="2">25</td><td rowspan="2">0</td><td rowspan="2">75</td><td rowspan="6">300</td><td rowspan="6">150</td></tr>
<tr><td>2. Asset Management Information System (AMIS)</td><td>2</td><td>20</td><td>80</td></tr>
<tr><td>3. Asset Database Analysis</td><td>2</td><td>20</td><td>80</td><td rowspan="2">20</td><td rowspan="2">0</td><td rowspan="2">80</td></tr>
<tr><td>4. Asset Replacement Plan</td><td>2</td><td>20</td><td>80</td></tr>
<tr><td>5. OJT 1: Asset Conditions Survey & Analysis</td><td>2</td><td>-</td><td>100</td><td rowspan="2">25</td><td rowspan="2">0</td><td rowspan="2">75</td></tr>
<tr><td>6. OJT 2: Introduction of GIS application in Asset Management</td><td>4</td><td>-</td><td>100</td></tr>
</table>

添付資料 3.48

2017 年春期研修カリキュラム

Curriculum for Training in Spring 2017

Course	Module	Time (days)	Methodology (%)		Evaluation (points)				Passing marks
			Theory	Practical	Attendance	Participation	Assignments	Total	
O&M of Tube Well and Pump Facility	1. O&M of Water Distribution System	4	60	40	20	0	80	100	50
Leakage Detection	1. Basic knowledge of Leakage Prevention Work	1	100	-	20	0	80	100	50
	2. Leakage detection and repair at the site (OJT)	1	0	100					
	3. Install & operation of the equipment at the site (OJT)	1	-	100					
	4. Visit to pipe factory	1	-	-					
	Action Plan	1	-	100					
O&M of Sewer And Storm Water Drainage	1. Safety control and measure for sewerage and drainage	3	60	40	25	0	75	100	50
	2. Operation and maintenance of drainage system	2	25	75	25	0	75	100	50
	3. Operation and maintenance of sewer system	4	40	60	25	30	75	100	50
O&M for Electrical Equipment	1. Electrical Panel and Instrumentation Equipment	5	33	67	30	0	70	100	50
	2. Generators		33	67	30	0	70	100	50
O&M for Mechanical Equipment	1. Centrifugal Pumps, Induction Motors and Valves	5	33	67	30	0	70	100	50
	2. Chlorination and Filtration System		33	67	30	0	70	100	50

Course	Module	Time (days)	Methodology (%)		Evaluation (points)				Passing marks
			Theory	Practical	Attendance	Participation	Assignments	Total	
	3. Water Meter Selection and Maintenance		33	67	30	0	70	100	50
	4. Heavy Machines		33	67	30	0	70	100	50
Business Planning	1. Business Planning & GAP analysis	2	40	60	5	5	40	120	60
	2. Strategies for Service Delivery Improvements	3	20	80					
	3. Strategies for Human Resource Development	2	40	60	5	5	60		
	4. Strategies for Financial Management System	1	20	80					
	5. Business plan formulation and implementation	2	20	80					

添付資料 3.49

コースおよび講師への評価に関する質問票（Form A、Form B）

Form A

Course Evaluation

Please provide your honest evaluation of the training course that you have just undertaken. Your evaluation will help to improve the future delivery of trainings by Al-Jazari Academy.

Sr. No.	How satisfied were you with:	Not Satisfied 1	Somewhat Satisfied 2	Satisfied 3	Very Satisfied 4
1	Difficulty level of training themes				
2	Quality of Training Materials (PPT Slides, Handouts, Lecture notes etc)				
3	Relevance of on-site training and field training activities				
4	Overall Presentation quality of Trainer(s)				
5	Trainer's expertise on topics and topics delivery skills?				
6	Time and length of training				
7	Practical activities and exercises at classroom				
8	Difficulty level of assessment and evaluation (assignment, exercises, project, action plan etc)				
9	Logistics arrangements such as (classroom, vehicles, tea and lunch etc)?				
10	Overall quality of the training?				

11) Would you like to recommend this course to your colleagues?

Yes ☐ **No** ☐

If no, then kindly give two major reasons

____

____

12) Kindly write two suggestions for further improvement of **Training Materials** (PPT Slides, Handouts, Lecture notes etc.?)

____

____

____

13) Two comments on overall training length and training timing.

____

____

____

14) Kindly provide two suggestions for further improvement related to site visits and field training activities.

15 a). Course Learning Outcomes (what extent were course learning outcomes accomplished?)

No.	Course Learning Outcomes	Accomplished	Not Accomplished
1	Ability to provide various types of leakages control measures		
2	Ability to operate leakage detection equipment		
3	Demonstrate SOPs for pipelines repair in professional manner		
4	Record and analyze of water network maintenance		
5	Prepare action plan for leakage detection prevention		

15 b) If your responses are more in negative, then please elaborate why do you think the course learning outcomes were not fulfilled?(three major reasons only)

Name: ____________________________ Signature: ___________________________

Note: The information contained in this form will be used for evaluation and analysis. We may also use your comments in certain publications/ reports.

Form B

Trainer(s)' Evaluation

Trainer Name: -- Course Name: ------------------------------------

No.	Items	Below average 1	Average 2	Good 3	Very good 4	Excellent 5
1	Qualification & experience					
2	Technical Knowledge of the content					
3	Explanation of content					
4	Demonstration and professional capability of handling equipment					
5	Use of different content delivery techniques (group discussion, activities, and exercises)					
6	Management of on- site trainings					
7	Time management					
8	Presentation Skills					
9	Quality of Learning materials (PPT slides, handouts, lecture notes)					

10) Any other suggestion or comment.

____
____
____

Name: ___________________________ Signature: __________________________

Note: The information contained in this form will be used for evaluation and analysis. We may also use your comments in certain publications/ reports.