



## Chapter One

# Preventative Maintenance Principles & Guidelines Booklet

*Outcomes from  
Advanced Technical Process Controllers' Workshops  
2011 & 2015*

*The experience is in the audience!*





Table of Contents

Rationale behind the Workshops..... 1

    Preventative Maintenance: Time for new Approach..... 1

1. Developing an Effective Preventative Maintenance Toolbox..... 2

2. Reactive Maintenance VS Preventative Maintenance..... 9

3. Why Preventative Maintenance? ..... 9

    What is your “destination”?..... 9

    Preventative Maintenance is Not a NEW idea or concept ..... 10

4. Effective Preventative Maintenance Planning..... 13

    4.1 Firstly Distinguish between a Task and a Project..... 13

    4.2 Planning for Preventative Maintenance ..... 15

5. Basic Requirements to Effective Maintenance Planning ..... 17

    5.1 Scheduling..... 17

        5.1.1 Scheduling Considerations..... 17

        5.1.2 How to schedule maintenance?..... 17

        5.1.3 Importance of Understanding the Processes at a Plant/Treatment Works ..... 18

        5.1.4 How to understand the processes of the plant? ..... 18

    5.2 Equipment Details: Asset Inventory..... 21

        5.2.1 Information required for an inventory ..... 21

        5.2.2 Organize the components..... 21

    5.3 Compiling an inventory ..... 22

    5.4 Environmental conditions & load ..... 23

6. Asset Management System..... 24

    6.1 Basic requirements expected from a capable Asset Management System..... 25

7. Preventative Maintenance Challenges ..... 27

    7.1 Generic Weaknesses and Threats for Preventative Maintenance Projects:..... 27

8. General Maintenance Guidelines ..... 31



8.1 Motors..... 32

8.2 Bearings..... 33

8.3 Couplings..... 34

8.4 Belt drives ..... 35

8.5 Gear Boxes ..... 36

8.6 Pumps..... 37

8.7 Valves ..... 38

Appendix: Answers and Input from the Audience..... 39





## Rationale behind the Workshops

At many workshops or presentations a “know it all” gentleman/lady presents a “beautiful” PPT show. Then, he or she allows ten minutes for questions, says “Thank you”, and leaves the audience with a copy of the PPT or a PDF. The important question to ask is: does the “know it all” presenter have any real practical experience? Or, has he/she, for instance, ever faced a broken sludge pump (on site) late afternoon or on a Sunday morning?

Maybe?

If one would guess; it is probably – NOT the case more than 90% of time

So, where is the real experience?

### ***Within the audience of Process Controllers!***

#### Preventative Maintenance: Time for new Approach

Possibly the most famous “words” of the century are: “Together we/you CAN do it!” But this doesn’t seem to help us much. Let us therefore try something different, namely: PPP–Public Participation Process, or rather **TPP–Technical Participation Process**. Why? **As mentioned, the experience resides in the Process Controllers in South Africa!**

#### ***So HOW do we extract it?***

If we consider humble vs presumptuous personalities and presume that around 70% of population are more humble – then most humble people never get a chance to respond verbally at meetings/workshops. At these WISA Process Controller workshops, however, things will be different and **everyone will participate!**

When delegates registered for these WORKSHOPS they effectively VOLUNTEERED to be:

**A CO-AUTHOR of Chapter 1 of: “PREVENTATIVE MAINTENANCE–A GUIDELINE”**

***See APPENDIX A for a list of all Co-Authors to this publication***

While we cannot write a guideline (book) in 2 hours, we can at least make a start with Chapter 1. So, let us change to the **NEW APPROACH** of: “Together we/you **WILL** do it!”

Let’s start by gathering the correct tools for the job...





## 1. Developing an Effective Preventative Maintenance Toolbox

What is a “WORKSHOP” without a “TOOLBOX”? Not really a ‘workshop’!

Therefore, the ‘Good News’ is that every audience member received a “Toolbox”. However, the ‘Bad News’ is that there are No “tools” in it. This mean that you must ‘collect’ or ‘make’ you own “tools”.

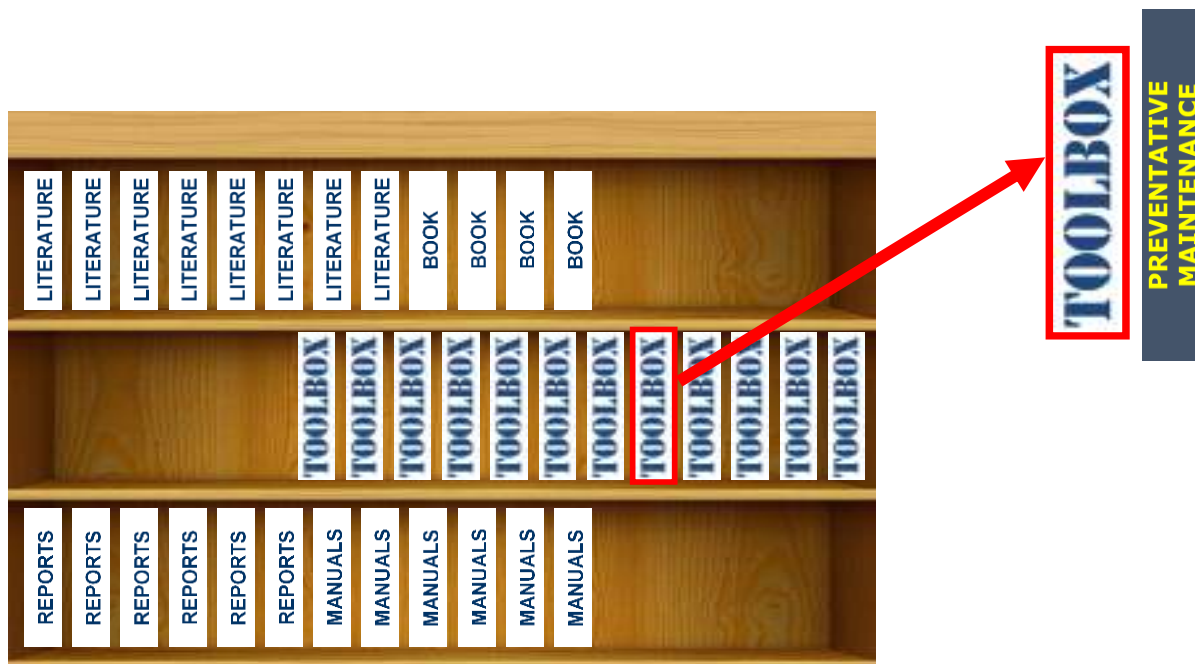
### Your own “workshop”

Your office and bookshelf with literature resources:

- BOOKS
- REPORTS
- MANUALS
- PREVENTATIVE MAINTENANCE “TOOLBOXES”

### IMPORTANT RULE:

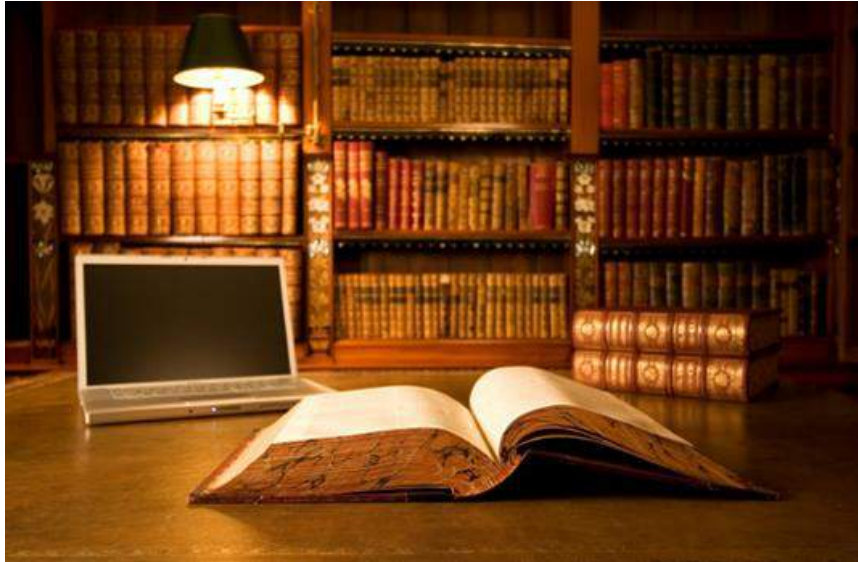
ONLY relevant books, reports, manuals, etc. are allowed in you toolbox. (Use another bookshelf for your car magazines and Wilber Smith books, etc.)





**Why is it difficult to win an argument against a good lawyer?**

**Because all the evidence and facts are in his/her “workshop” and “toolboxes” (at hand)**



**Remember:**

**Google or Wikipedia will not win the argument!**

*(Jy gaan jou naam g.... maak!)*

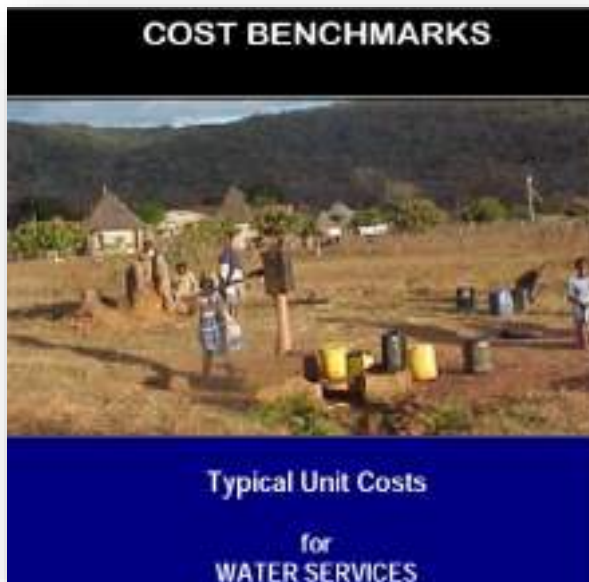
**So begin by selectively ‘creating’ your own ‘toolbox’.**

**The following lists are examples of ‘tools’ from which you can select what you deem important in filling up your own ‘toolbox’.**

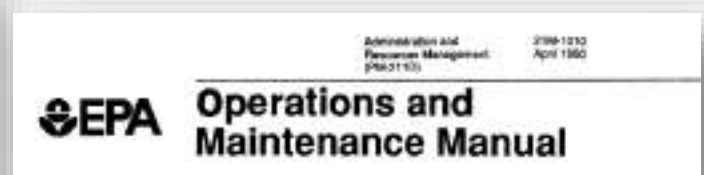
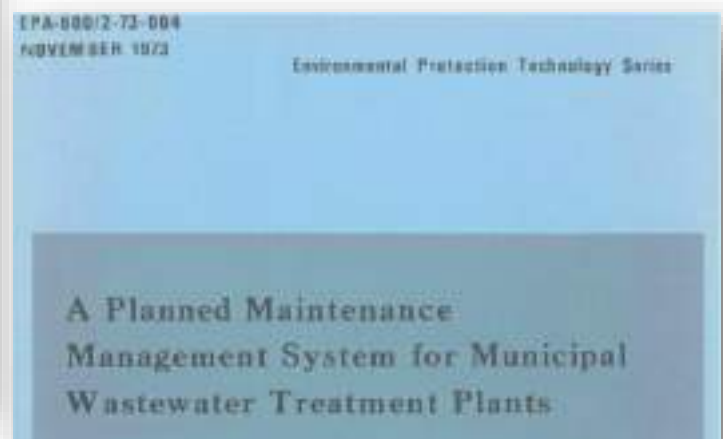




## General literature:



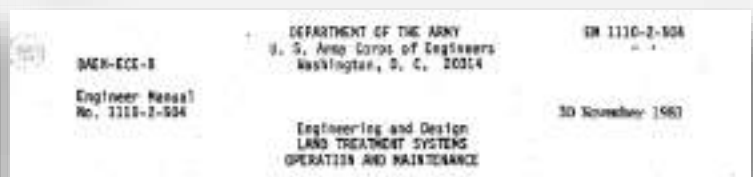
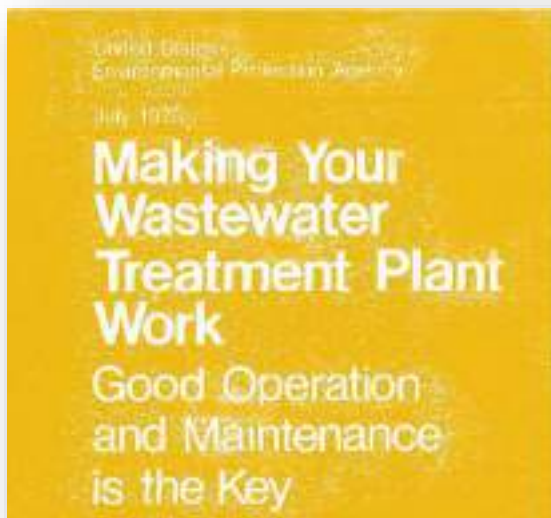
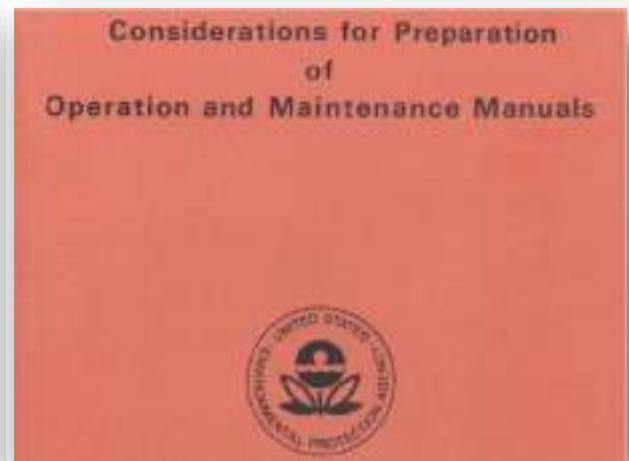
Chapter 22: "Handbook For The Operation Of Wastewater Treatment Works". WISA. Order the book.



[www.wamsys.co.za](http://www.wamsys.co.za)



- **Another point of view:** USEPA & USACE
- USEPA: 1973 –Planned Maintenance Manual > 200 pages

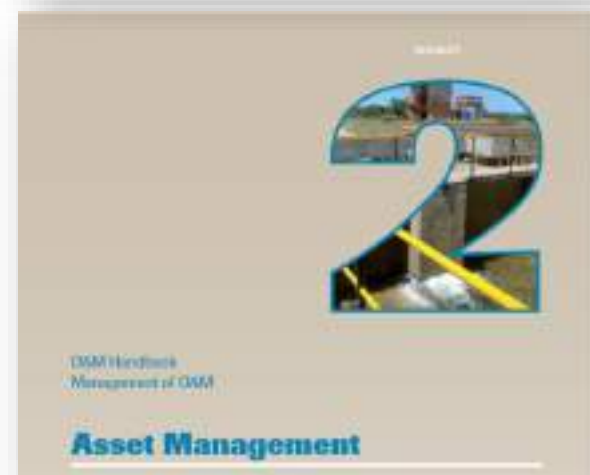
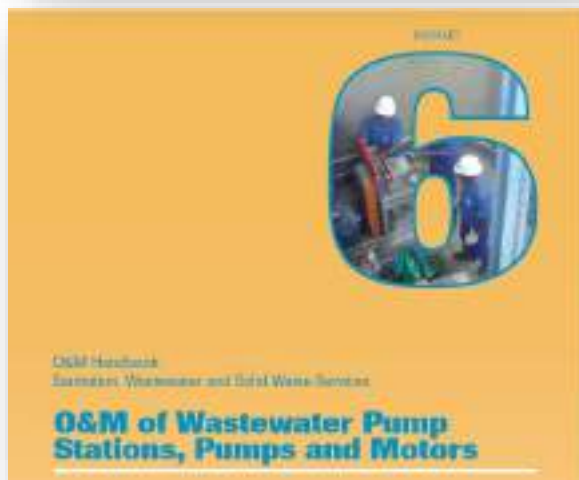
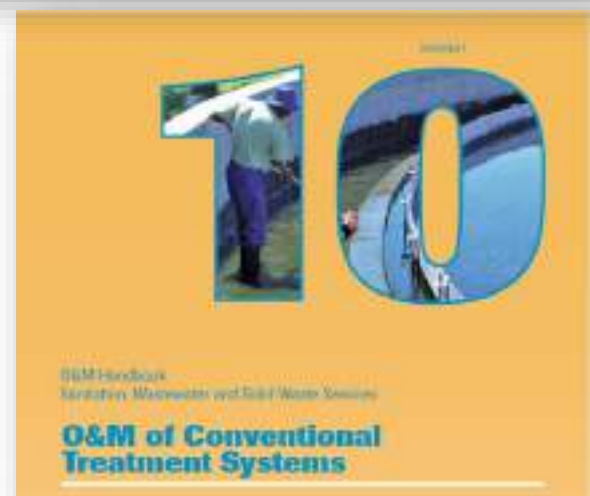






## “Brilliant” set of documents:

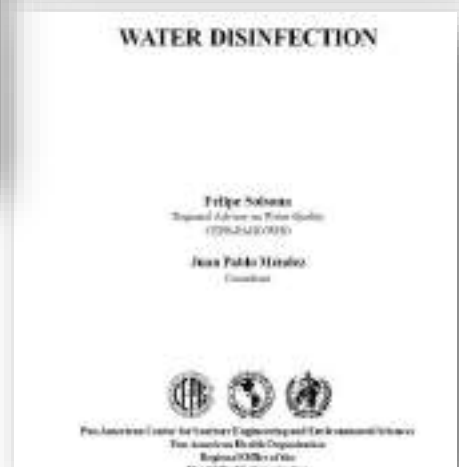
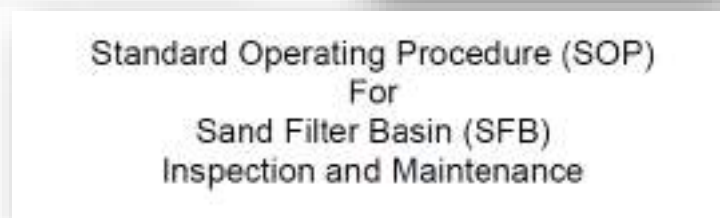
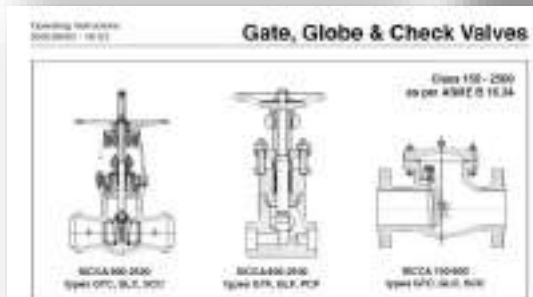
- More than 50 booklets



Etc...



## Technical Documents:







And for continuity...the 2011 WISA Preventative Maintenance Presentation.



*Make use of the notes, presentations and documents of previous Workshops on Preventative Maintenance – they are valuable ‘tools’*





## 2. Reactive Maintenance VS Preventative Maintenance

Reactive Maintenance implies waiting until something breaks down and then fixing it – it is essentially the same as ‘firefighting’ and is not a sustainable or cost-effective way to manage a water or waste water plant (or any other infrastructure asset!)

Reactive “Maintenance” = Emergency!

It is the same as for an unmaintained car that breaks down:

You will get stuck in the middle of nowhere

...and have to pay the tow truck & pay for repairs (possibly a new engine!)

Your day is #&\$@\*!!!!

MOST IMPORTANTLY

You do not reach your destination!

*Reactive: wait till it breaks down and then fix it (i.e. ‘firefighting’) =*

*INEFFICIENT and COSLTLY!*

Preventative Maintenance is routinely done to ensure nothing breaks down. Prevention is always better than cure!

## 3. Why Preventative Maintenance?

- ✓ Preventative maintenance is CHEAPER and is BUDGETED FOR
- ✓ If running at plant capacity or in the case of a critical component - entire plant can be at a standstill if maintenance is reactive/not planned well (similar to a car’s engine breaking in the middle of the Karoo)
- ✓ Preventative is scheduled – you can manage your time and let every day be a joy ride
- ✓ MOST IMPORTANTLY: You will reach your “destination”!

**What is your “destination”?**

***Water Quality and Sustainable Service Delivery!***





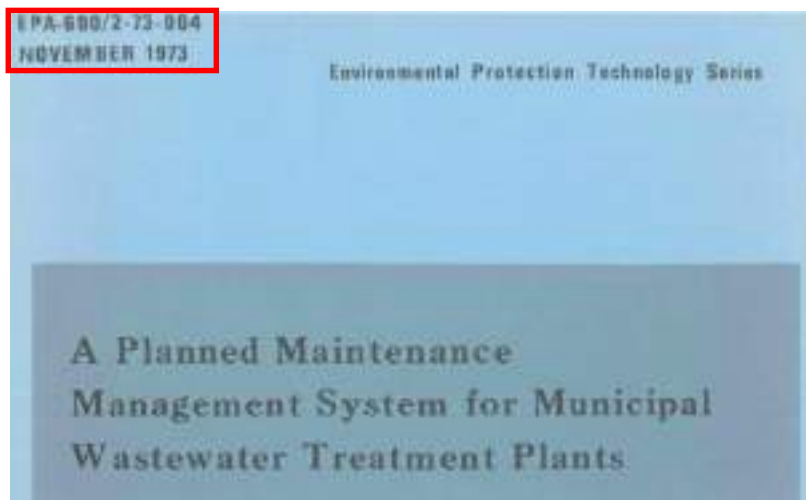
## Is it a NEW concept?

We should recognise that:

**Preventative Maintenance is Not a NEW idea or concept**



**City of Sour in Lebanon: 2000 years ago – maintained a sewage and water system for >150 years**



**USEPA: 1973 – Planned Maintenance Manual for Municipal Waste Water Treatment Plants > 200 pages**

*Considering present day materials (stainless steel, HDPE, PVC, etc.) and the condition of some infrastructure, < 10 years old, it often seems that we are bettered equipped to compile a manual on “deliberate destruction” than on “preventative maintenance”...!*





## Examples of failures: Present day incidents in South Africa







Look after your “car”  
Make sure that it is serviced regularly, and  
that  
You drive it carefully – according to  
specifications and according to legislation &  
regulations.



## 4. Effective Preventative Maintenance Planning

### 4.1 Firstly distinguish between a Task and a Project

*You see 'something' in the sky:*

***Is it a bird or a plane?***

***What is common?***

***Both can fly! That is all!***

*You receive an instruction to do 'something' at work:*

***Is it a TASK or a PROJECT?***

***What is common?***

***Language! That is all!***

***Consider the following:***

**CRC (Current Replacement Cost) costs for 80 Ml/day plant: > R500 million**



**Estimated maintenance cost: > R7 million per year** *(Estimate based on: DWA, Cost Benchmarks)*







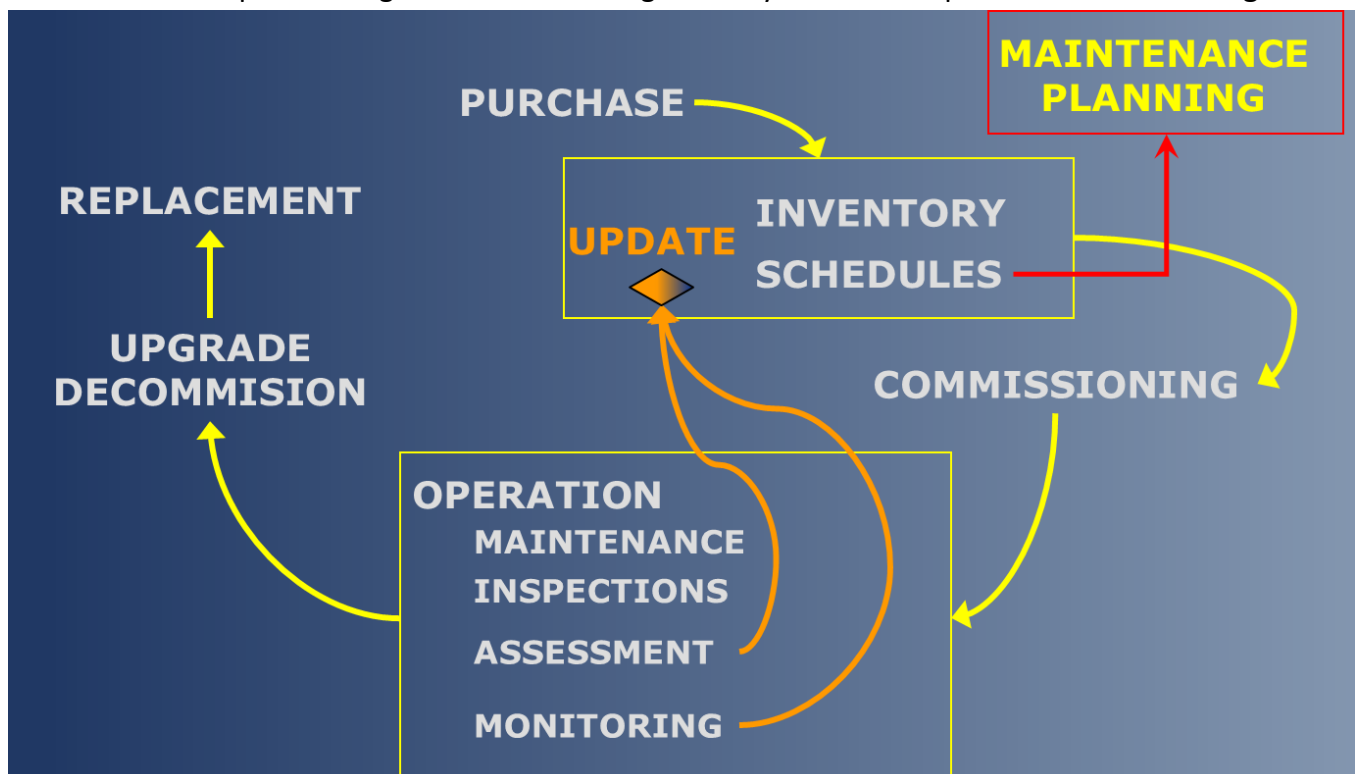
### Capital Costs per Scheme Size (in 2007)

Sewage Treatment Conventional Treatment Works Capital Cost (excl. fees, P&G +)	
Component/Description	Sewage Treatment Works
Sum of CapCost	Scheme Size Capacity Capacity Unit
	Very Small (1000 people) Small (5000 people) Medium (20000 people) Large (50000 people)
Element	300 1000 5000 10000
Civil Works	R 1 239 336 R 4 131 120 R 21 245 760 R 35 409 600
Electrical Equipment	R 247 867 R 826 224 R 4 249 132 R 7 051 820
Mechanical Equipment	R 371 801 R 1 239 336 R 6 373 728 R 10 622 880
Pipework	R 206 556 R 688 520 R 3 540 960 R 5 901 600
Total	R 2 065 560 R 6 885 200 R 35 409 600 R 59 016 000

Therefore, given the significant capital cost involved for proper refurbishment, it is often NOT a TASK, but a **PROJECT**

...and when the maintenance costs of a plant is R7 million, Preventative Maintenance should also be regarded as a PROJECT and not merely a task.

Thereafter it is important to get an understanding of the cycles and components of **asset management**:







## 4.2 Planning for Preventative Maintenance

Take for instance Paarl Waste Water Works:



**It has > 3500 components that need to be maintained!**



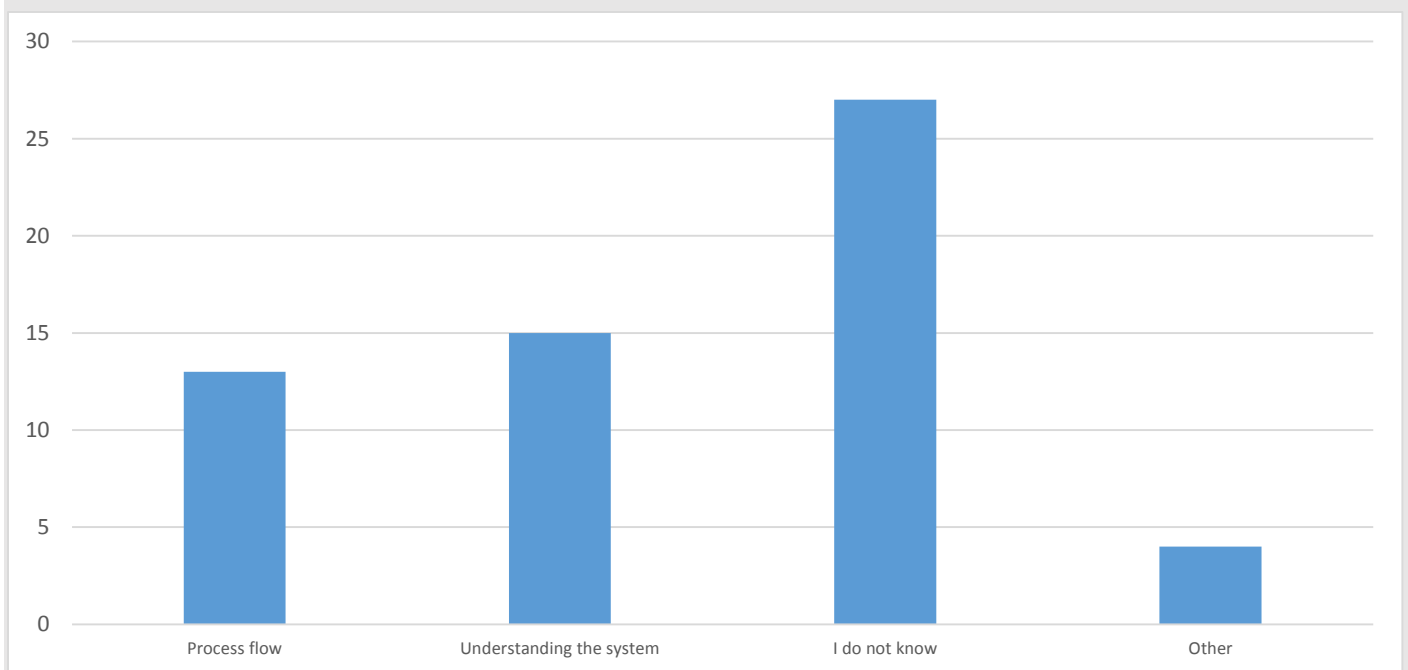
## So, where do you start?

By understanding, compiling and implementing certain **Basic Maintenance Requirements and Information**, namely:

- **Mechanisms to Schedule and Budget**
- **Equipment details**
- **Resources**
- **Available Funds**
- **Mechanism to Assess and Monitor**
- **Mechanism for Record Keeping and Reporting**

### Workshop Responses (see Appendix B)

#### Question 1: Where do we **start?**





## 5. Basic Requirements to Effective Maintenance Planning

### 5.1 Scheduling

#### 5.1.1 Scheduling Considerations

##### Inputs

###### Time considerations:

- Month, 3, 6 months, annual
- For next 3 years

###### Provision for:

- Resources (internal and external)
- Running costs

###### Taking into account:

- Age
- Condition
- Usage (hours)
- Guarantees

##### Outputs

###### Operational:

- Schedule summary: **Completed, due, not completed**
- Early warning mechanism
- Job cards

###### Financial:

- Budget provision
- Estimated vs Actual cost
- Cash flow

#### 5.1.2 How to schedule maintenance?

It is ONLY possible if you:

- Understand the processes (the heart throb of the plant)
- Have a detailed technical inventory
- Adhere to manufacturer's specifications and requirements





### 5.1.3 Importance of Understanding the Processes at a Plant/Treatment Works

#### ***Why is it important to know the processes in the plant?***

You can ONLY draw-up a technical inventory of a plant if you understand the processes and have a thorough knowledge of the technical components of the plant!

- Maintenance cannot be done without a “road map” of the functional and dynamic processes and the relevant critical components along the “road”
- What happens if the “know-all” person (who have work for decades on a plant) leaves – DISASTER

**Remember: Planning, scheduling, execution and control of maintenance is a team effort (we can do it!)**

### 5.1.4 How to understand the processes of the plant?

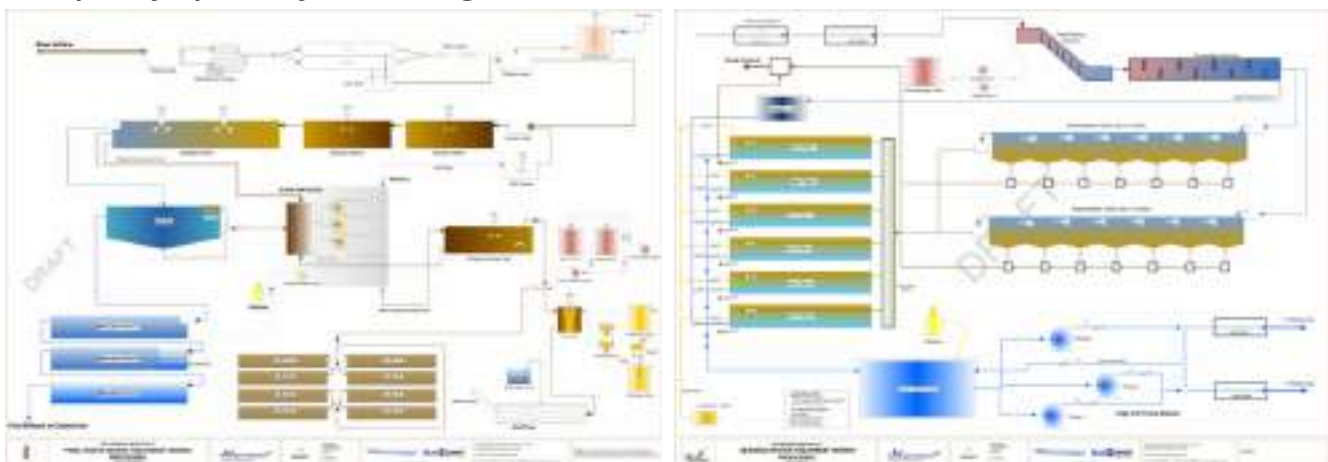
You collect all technical info - Drawings, manuals, etc.

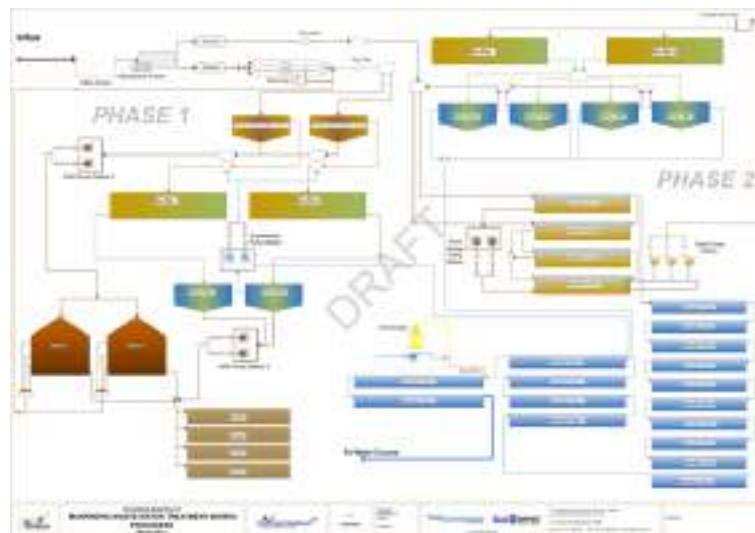
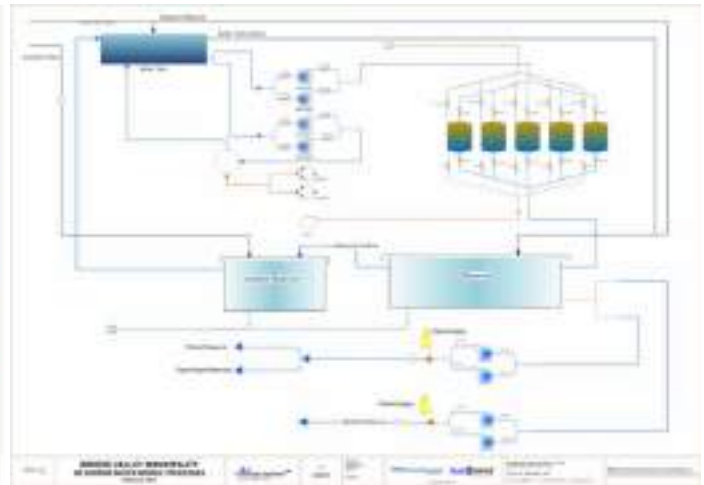
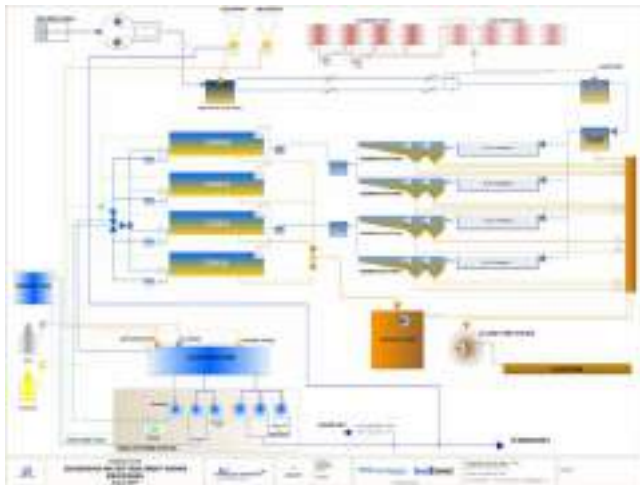
- ✓ You go out on site: Make sure you have enough papers, pens, etc.

You ask yourself the following:

- ✓ From where is it coming?
- ✓ Where is it going?
- ✓ You make a process drawing, including all the valves, meters, pumps, sumps, etc. along the lines of the “flowing” direction.

#### ***Examples of a process flow drawings***









What do you do if you do not know the processes and components in the plant?

- You ask your colleagues
- You walk, climb, crawl, open manholes and have a closer look.

If you still do not understand, you go down on your hands and knees.... You go closer and closer and closer and closer....







## 5.2 Equipment Details: Asset Inventory

**Preventive maintenance can only be planned, scheduled, implemented and executed if you have a **complete inventory!****

- An inventory is a detailed technical summary of your plant.
- You can only draw-up an inventory of a plant if you understand the processes.
- You can only draw-up an inventory if you have a thorough knowledge of the technical components of the plant!

A detailed inventory can be seen as the **roadmap to scheduled maintenance.**

### 5.2.1 Information required for an inventory

- **Description (Name)**
- **Type: Electrical, Mechanical, Structural, Instrumentation or General**
- **Photos: To show features and looks of the equipment.**
- **Size (capacity): e.g. Motor (20 kW), Gate Valve (200mm)**
- **Serial No**
- **Inventory No**
- **Supplier (contact name and address)**
- **Responsible staff member**
- **Quantity (if more than 1)**
- **More notes (comments)**
- **Date Purchased**
- **Manuals**
- **Operational guides**
- **Correspondence, manuals, orders, invoices, etc. (file types: JPG, PNG, PDF, DOC, XLS, TXT, etc.)**

### 5.2.2 Organize the components

- **Main categories (main processes):** Why? Different staff at inlet works, pump stations, digesters, etc.
- **Sub categories (equipment type – e.g. electrical, mechanical and civil infrastructure):** Why? For example: A mechanic is not allowed to service a switchboard



Then also record the following:

- Age
- Condition (history of assessments)
- Guarantee of equipment
- Supplier
- Value (purchase and replacement)
- Technical (manuals)
- Performance (history)
- Maintenance history (technical & costs – reactive & planned maintenance)

### 5.3 Compiling an inventory

Follow a systematic approach:

*Imagine you are 'something' in the water/waste water stream... swim with the stream and explore; inspect everything around you. Look at all the different components of all the assets that you flow through. Ask yourself: when you get to the other side, will you be clean?*

Consider for example all the different components present on a pump:



*Inlet pipe, inlet valve, inlet pipe pressure gauge, mounting, pump, coupling, motor, outlet pipe pressure gauge, outlet pipe butterfly valve, outlet pipe...*



What do you do if you are not 100% sure about the state and details of your equipment?

- You ask your colleagues
- You walk, climb, crawl, open manholes and have a closer look.



#### 5.4 Environmental conditions & load

Preventive maintenance scheduling is not straight forward and does not depend only on a manufacturer's guidelines. Also consider the following environmental and load conditions:

- **Location - Inside/outside**
- **Usage**
  - Function of use?
  - In use?
  - Stand by?
  - Spare?
  - Not in use?

All the above inventory and asset condition information needs to be capture in an adequate asset management system...





## 6. Asset Management System

Let's imagine you take an Advanced 4 x 4 Driving Course: You receive and understand all technical details.

OK – now for a practical session! Get your vehicle!



?

What is missing here?

*You need the proper equipment for the job! You can't drive 4x4 with the wrong car, the same as you can't do asset management with an inadequate system!*





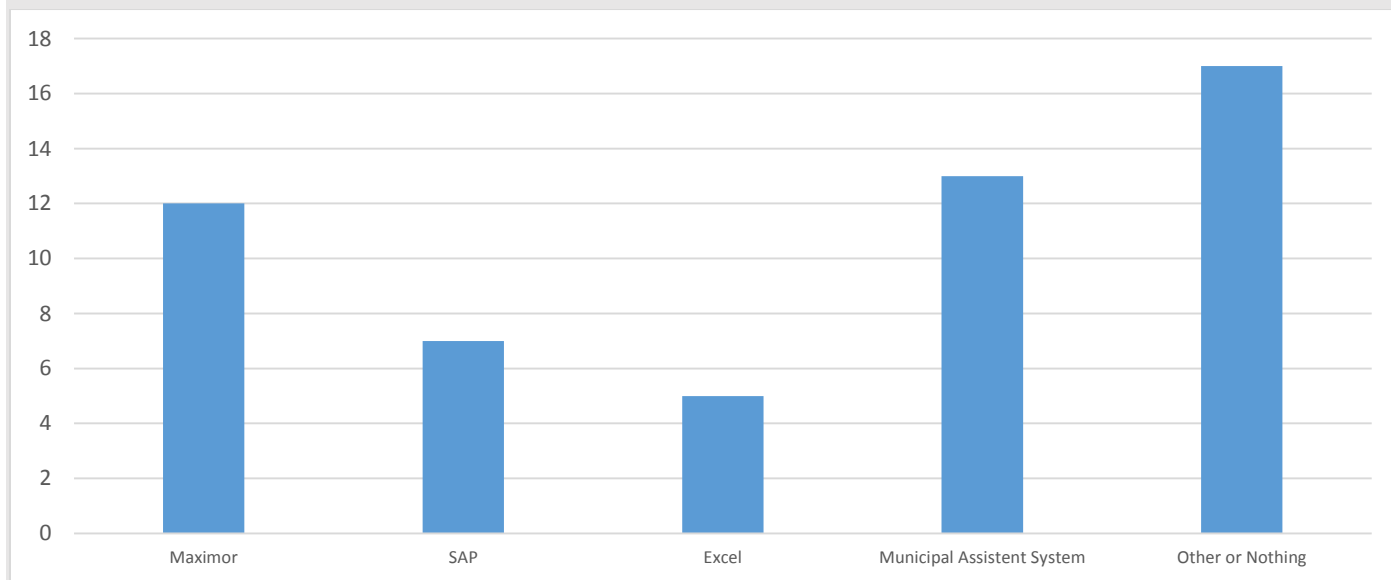
## 6.1 Basic requirements expected from a capable Asset Management System

- **Inventory**
  - Auto calculation of RUL (Remaining Useful Life)
  - Auto update of CRC (Current Replacement Cost)
  - Provision for attachments (documentation & photos)
- **Condition Assessments (history of)**
  - List priorities (High, Medium, Low, and OK)
- **Preventative maintenance scheduling**
- **Reactive maintenance (events – description, costs, impact, contingency measures)**
- **Reporting**
- **Financial requirements: GRAP 17, SCOA**
- **Risk assessments (vulnerable components and processes)**
- **Technical aids (calculations, process flow, etc.)**

Think of the Asset Management system you currently use and ask yourself:  
***Is it sufficient?***

### Workshop Responses (see Appendix B)

Question 2: Which **Asset System** do you use?





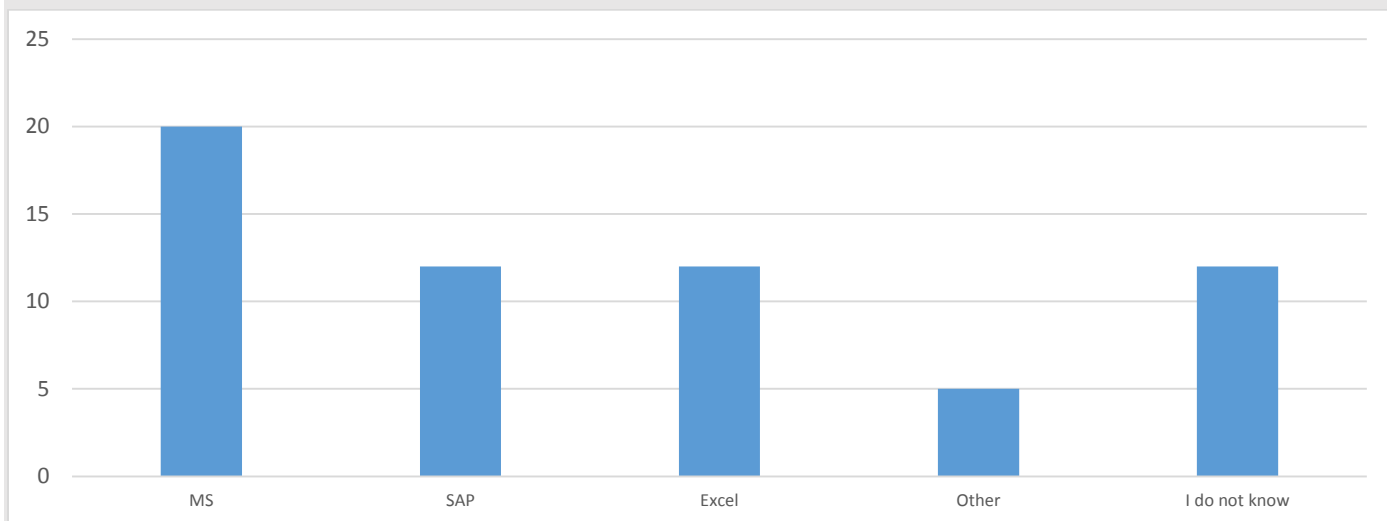
Remember: A Major Project (not a task) requires the following:

- **Project management**
- **Project manager**
- **Project management system**

Think of the Project Management system you currently use and ask yourself:  
***Is it sufficient?***

Answers from the Audience (see Appendix B)

Question 3: Which **Project Management System** do you use?



For any project: You **MUST** do an honest SWOT analysis

**SWOT?**

- **Strengths** (work force, funds, know-how, proper equipment, etc.)
- **Weaknesses** (lack of skills, lack of funds, lack of knowledge, lack of equipment, etc.)
- **Opportunities** (job security and satisfaction, promotion, proper service delivery, etc.)
- **Threats** (labour strikes, equipment failure, poor planning – over budget – over timeframe, etc.)

*If not:*

*Use your PC for the last time to: Type your resignation or Close your business...*





## 7. Preventative Maintenance Challenges

*Identify **CHALLENGES** before you encounter it*

*Every project requires its own issue analysis - in simple language these are **PROBLEMS***

*Let us be positive: **PROBLEMS** are **CHALLENGES**!*

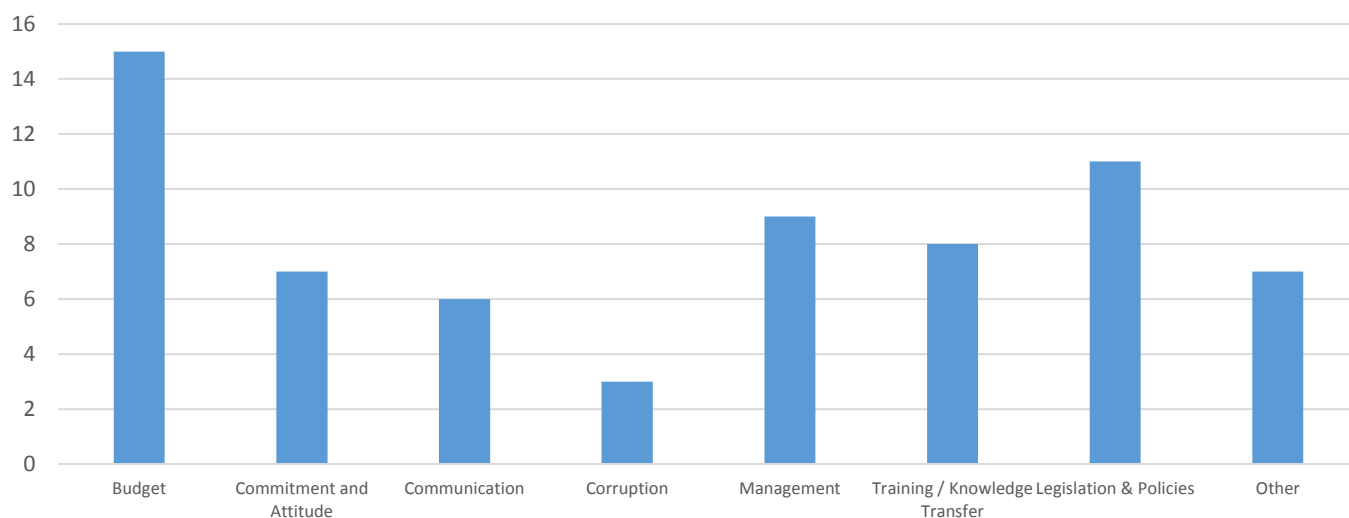
### 7.1 Generic Weaknesses and Threats for Preventative Maintenance Projects:

#### Institutional Challenges

- Legislation
- Policies
- Higher level commitment

#### Workshop Responses (see Appendix B)

Question 4: What are your **institutional challenges** when planning preventative maintenance?





### Organizational Challenges (within municipality of water board)

- Resources
- Roles and responsibilities
- Communication
- Knowledge and information sources
- Knowledge transfer (sustainability of know-how)
- Training
- Leadership
- Procurement procedures
- Filing and record keeping

### Workshop Responses (see Appendix B)

Question 5: What are your **organizational challenges** when planning preventative maintenance?



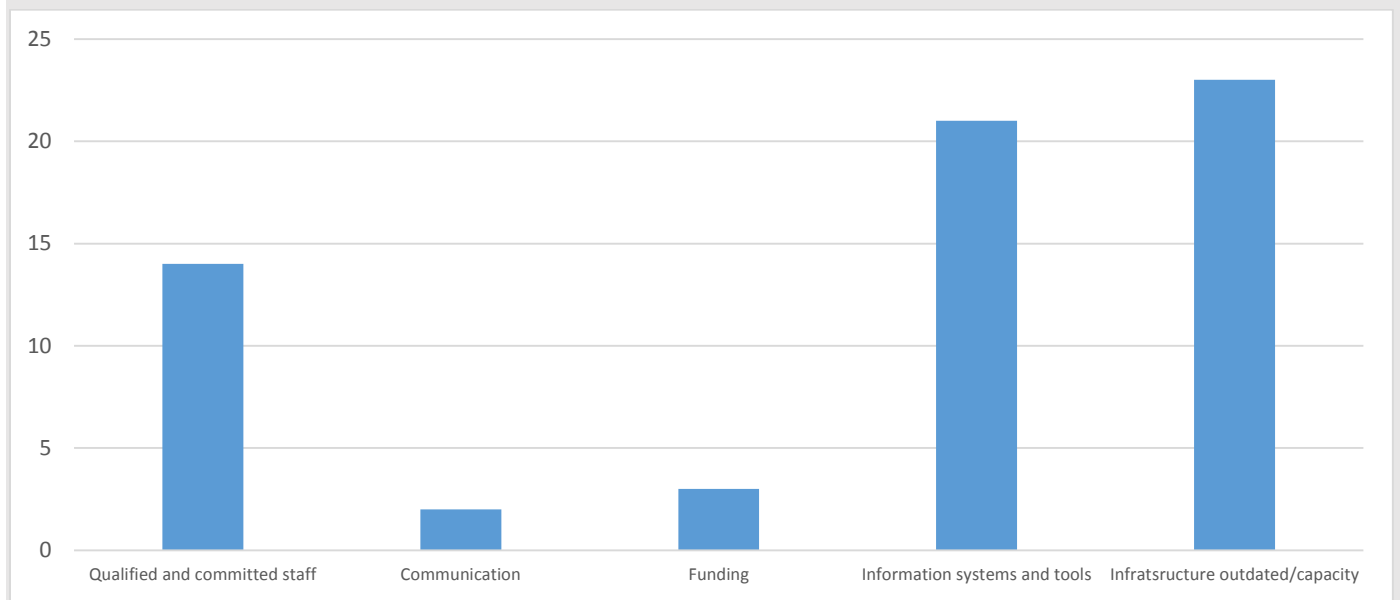


### Technical Challenges

- Lack of “tools” (systems)
- Lack of standards
- Lack of technical procedures
- Equipment/infrastructure - outdated
- Equipment/infrastructure – passed lifespan
- Equipment/infrastructure – lack of or limited capacity

### Answers from the Audience (see Appendix B)

Question 6: What are your **technical challenges** when planning preventative maintenance?





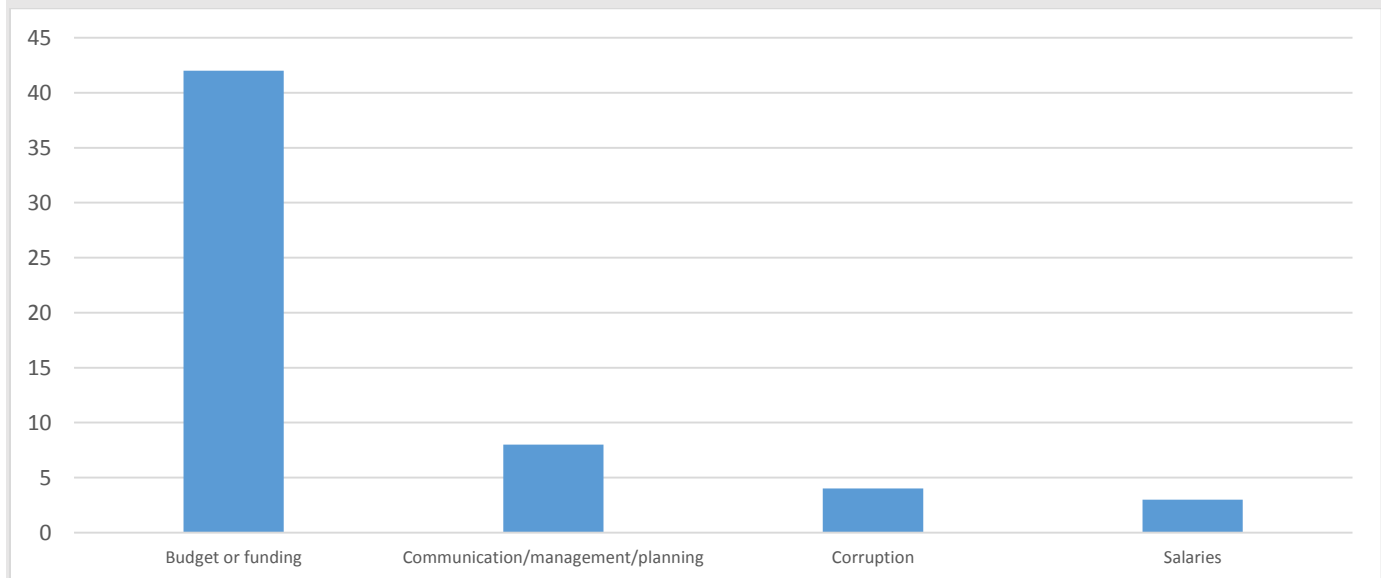


### Financial Challenges

- Funding (short term)
- Funding (long term)
- Link (operational systems to financial system)
- Timeous reporting
- Budgeting -inputs
- Cash flow management

### Answers from the Audience (see Appendix B)

Question 7: What are your **financial challenges** when planning preventative maintenance?





## 8. General Maintenance Guidelines

Numerous water and waste water treatment works and infrastructure (including reservoirs, pump stations, distribution network pipes, etc.) are much more than 20 years old. Consequently, there are no more supplier's guarantees, manuals are lost, and standard operating procedures are not in place, etc. It is however important to start (maintenance procedures) somewhere, as all old equipment currently in use are all still very critical to the delivery of sufficient quality & quantity drinking and treated waste water. Some general guidelines obtained from assessing more than 50 municipalities and more than 200 WTW and WWTW, are listed below.

### Main Mechanical Components

- **Motors**
- **Bearings**
- **Couplings (flexible, rigid, etc.)**
- **Belt drives**
- **Gear boxes**
- **Pumps (centrifugal, multistage, rotor, etc.)**
- **Valves (gate, butterfly, globe, ball, check, air, etc.)**
- **Pipework (pipes, flanges, couplings, etc.)**
- **Screens**



## 8.1 Motors



### Motor maintenance - Monthly

- Clean any dirt/oil/contaminant
- Check for excessive current draw, vibration, noise & temp.
- Ensure mounting bolts are properly tightened
- Examine for any mechanical damage or corrosion
- Remove corrosion & paint
- Ensure free unobstructed ventilation

### Motor maintenance – Annually (Depending on usage)

- Strip down motor, removing rotor from stator.
- Clean all parts thoroughly
- Examine bearings if rough replace alternatively clean & re-grease
- Measure winding insulation with 500 V megger
- Replace oil seals
- Reassemble and ensure free rotation of shaft.





## 8.2 Bearings

# Bearings



### Bearings - Monthly

- Clean thoroughly
- Check for excessive vibration, noise & temp.
- Check for sufficient lubrication
- Examine for any mechanical damage or corrosion
- Remove corrosion & paint

### Bearings – Six Monthly (Depending on usage)

- Examine bearings - if rough replace alternatively clean & re-grease
- Grease all grease points



### 8.3 Couplings



#### Couplings - Monthly

- Clean any dirt/oil/contaminant
- Check for excessive vibration, noise & temp.
- Ensuring proper alignment
- Ensure mounting bolts are properly tightened
- Examine for any mechanical damage or corrosion
- Remove corrosion & paint

#### Couplings - Annually (Depending on usage)

- Strip down
- Clean all parts thoroughly
- Examine bearings if rough replace alternatively clean & re-grease
- Reassemble and ensure free rotation of shaft.
- Reinstall, ensuring proper alignment





## 8.4 Belt drives



### Belt drives - Monthly

- Clean any dirt/oil/contaminant
- Check for excessive vibration, noise & temp.
- Check pulley alignment & belt tension
- Ensure mounting bolts are properly tightened
- Examine for any mechanical damage or corrosion paying special attention to belts and pulleys
- Remove corrosion & paint

### Belt drives - Annually (Depending on usage)

- Strip down
- Clean all parts thoroughly
- Examine bearings if rough replace alternatively clean & re-grease
- Reassemble and ensure free rotation of shaft.
- Reinstall, ensuring proper alignment and belt tension





## 8.5 Gear Boxes



### Gear Boxes – Monthly

- Clean any dirt/oil/contaminant
- Check for excessive vibration, noise & temp.
- Check oil level
- Ensure mounting bolts are properly tightened
- Examine for any mechanical damage or corrosion
- Remove corrosion & paint

### Gear boxes - Annually (Depending on usage)

- Strip down
- Clean all parts thoroughly
- Examine bearings if rough replace alternatively clean & re-grease
- Reassemble and ensure free rotation of shaft.
- Refill with new oil



## 8.6 Pumps



### Pumps - Monthly

- Clean any dirt/oil/contaminant
- Examine for any mechanical damage or corrosion
- Check while running for excessive vibration, noise & temp.
- Ensure mounting bolts are properly tightened
- Inspect mechanical seals for leaks
- Check operation of non-return valves
- Remove corrosion & paint

### Pumps - Annually (Depending on usage)

- Strip down
- Clean all parts thoroughly
- Inspect impeller for any signs of mechanical damage or corrosion
- Replace mechanical seal
- Reassemble and ensure free rotation of shaft.
- Reinstall, ensuring proper alignment





## 8.7 Valves



### Valves – 1 to 6 Months

- Clean any dirt/oil/contaminant
- Lubricate spindles, gears & other working components
- Move valve from open to close position and back particularly if not in regular use
- Ensure bolts are properly tightened
- Examine for any mechanical damage or corrosion
- Remove corrosion & paint

***Water is life!***  
***Together we/you ARE DOING it!***



## Appendix A: Author & Co-Authors

AUTHOR AND WORKSHOP FACILITATOR	AFFILIATION
Willem Botes	WAMTechnology CC
CO-AUTHOR: NAME & SURNAME	AFFILIATION
Alice Punt	WAMTechnology CC
Wighens Ngoie Ilunga	Biocatalysis & Technical Biology Research Group CPUT
Danie Klopper	DNK Consulting Services CC
Bennie de Reuck	Indecon Instrumentation
Jordy Fortuin	Sustainable Engineering Consultants
Uthi Skepe	Student
Enaas Richards	Sustainable Engineering Consultants
Peter King	Retired
LeRoi Pols	DWS
Willem de Kock	Stellenbosch Municipality
Florance Casper	Stellenbosch Municipality
De Villiers Esterhuizen	Lonza Water Treatment
Ronald Mambwe	CPUT
Werner Rössle	City of Cape Town
J Van Wyk	WSSA
M Watson	Drakenstein Municipality
T Simons	Drakenstein Municipality
T Ontong	Drakenstein Municipality
N van der Westhuizen	Drakenstein Municipality
L Marquard	Drakenstein Municipality
M Cornelissen	Drakenstein Municipality
D Philander	Drakenstein Municipality
G Swart	Drakenstein Municipality



Michael Toll	CoCT
Warren Retief	Emanti
Goosen le Roux	Overstrand Municipality
Vuokko Laurila	WATERMASTER
Ms. Alice Lubega	Rand Water
Ms. Nokukhanya Sishi	Rand Water
Ms. F. Sotywambe	Rand Water
Mr. Gerald Molley	Rand Water
Ernest Joseph	Theewaterskloof Municipality
Rico Adams	Theewaterskloof Municipality
John Palmer	Theewaterskloof Municipality
Marlin Fortuin	Theewaterskloof Municipality
Owen Bruce	Theewaterskloof Municipality
Marchel Rule	Theewaterskloof Municipality
Mario Solomons	Theewaterskloof Municipality
Charlene van der Riet	Theewaterskloof Municipality
Adrian Stryers	Theewaterskloof Municipality
Hegans Marthinus	Theewaterskloof Municipality
Farouk Robertson	WISA Council
Gareth Mconkey	Jantech cc
Mbalekelwa David Mkhwane	Rand Water
Lesego Selowa	Rand Water
Poppy Mtshweni	Rand Water
Orapeleng Venetia Nkwe	Rand Water
Khayaletu Ntlebi	Rand Water
Tlou Evelyn Mabusela	Rand Water
Angelinah Mohlago Moekwa	Rand Water



Itumeleng Felicity Ramasodi Affiliate	Rand Water
Itumeleng Maeko	Rand Water
Blake Schraader	SANParks
Barrend du Plessis	SANParks
Israel Manyasele	Witzenberg Municipality
Adam Carelse	Witzenberg Municipality
Andy Nel	Witzenberg Municipality
Franklin Lewis	Witzenberg Municipality
Abraham Daniels	Witzenberg Municipality
Faizel Jumath	Witzenberg Municipality
Swannie Swanepoel	Witzenberg Municipality
Jacobus Jacobs	Stellenbosch Municipality
KIM NICOLAY	WATERMASTER SOUTHERN AFRICA
A Malgas	Witzenberg Municipality
K West	Drakenstein Municipality
D. Walker	
F. Sotywambe	
Amina Sulaiman	DEA (Development & Planning)



## Appendix B: Responses from the Audience

### Question 1: Where do we **start** (when implementing preventative maintenance)?

• Inlet Works	• Components that needs to be place	• I don't know
• Walk the plant	• Critical components	• I don't know
• Inlet Works	• No idea	• At the beginning
• Inlet Works	• O&M	• In the beginning
• Inlet Works	• Risk assessment	• Tool box with the correct tools
• Inlet Works	• Planning	• Schedule maintenance
• Inlet Works	• Set-up a monitoring system	• What needs to be done
• Inlet Works	• Somewhere	• I don't know
• At the beginning	• I want to know	• The components that are critical
• At the beginning	• Myself to be positive, good attitude	• I don't know
• Start at the beginning of the works	• Educate yourself	• Compiling a list of components
• I don't know	• Start in yourself	• Gathering of previous documents
• I don't know	• I don't know	• First do a check up on the plant
• I don't know	• I don't know	• I don't know
• Create a maintenance schedule	• Check-up on the plant	• I don't know
• make use of my tool box	• Create an inventory of all equipment	• I don't know
• I will start by having an article, good technical background study and general process overview of the whole plant	• Making sure that all the processes are well monitored then I will know that my first step in preventing is done	• Do an asset inventory to determine equipment status
• Staff who understand how WWTW works that can identify the maintenance needs	• Maintenance analysis to identify possible gaps	• Start with the product which cause the biggest problem
• Create an inventory list for all equipment	• Staff that understand how to operate a plant	• I don't know. I want to know more about PC
• Skills and training	• Learning	• Inventory list
• I don't know	• Knowing the functionality of equipment	• Is everyone on the same page as where to start



## Question 2: Which **Asset System** do you use?

• Maximor	• SAP	• MA system
• Maximor	• SAP	• MA system
• Maximor	• SAP	• MA system
• Maximor	• SAP	• Staff break downs
• Maximor	• SAP	• Staff break downs
• Maximor	• SAP	• Staff break downs
• Maximor	• Request for plant by asses dept.	• Staff break downs
• Maximor	• Excel	• I don't know
• Maximor	• Excel	• I don't know
• Maximor	• System made in Excel	• I don't know
• Maximor	• Excel	• Don't have any system
• Maximor	• Excel	• N/A
• SAP	• MA system	• Use MA, but at the moment none
• Breakdown maintenance	• MA system	• Usually wait till stuff breakdown
• Appropriate request from plant	• MA system	• Date to date service plan
• Chlorinator chip dozer	• MA system	• Electrical system
• MA system	• MA system	• MA system



### Question 3: Which **Project Management System** do you use?

• MS	• I don't know	• Excel
• MS	• I don't know	• Excel
• MS	• I don't know	• Excel
• MS	• I don't know	• Excel
• MS	• I don't know	• Excel
• MS	• I don't know	• SAP
• MS	• I don't know	• SAP
• MS	• I don't know	• SAP
• MS	• I don't know	• SAP
• MS	• I don't know	• SAP
• Do not know	• I don't know	• SAP
• Chart system Excel	• Plant under EMIS	• Own system
• Enterprise project management	• IMQS	• Making use of Maintenance filling system
• MS	• Excel	• SAP
• MS	• Excel	• SAP
• MS	• Excel	• SAP
• MS	• Excel	• MS
• MS	• Excel	• MS
• MS	• SAP	• MS
• MS	• SAP	• SAP





**Question 4: What are your institutional challenges when planning preventative maintenance?**

• Policies	• Information knowledge	• Budget
• Policies	• Human resource	• Budget
• Policies	• Time	• Budget
• Policies	• Training	• Budget
• Policies	• Resource	• Budget
• Policies	• None qualified	• Higher level challenges
• Compliance with authorization	• Not willing to learn employees	• Cultural challenges
• Bad Communication	• Incompetent personnel	• Legislation
• BBEE law	• Budget	• Legislation
• Lazy operations	• Attend more works	• Legislation
• Corruption	• Budget	• No compliance
• Commitments	• Budget	• Grey areas
• Commitments	• Budget	• Plant not well maintained
• Commitments	• Budget	• Data collection problem
• Commitments	• Budget	• Management turnaround
• High pollution	• Budget	• O&M
• Lack of personnel	• Budget	• Ring-fencing WTW and WWTW budgets
• Lack of knowledge	• Budget	• Full unique details
• Operational maintenance	• Bureaucratic management	• Asset management plan
• Not well communicated	• Aged infrastructure	• COCT- Silo Operation
• Funds not always available	• Lack of top management involvement	• Abundant use of consultants vs. up skilling in-house labor
• Lack of Communication technology are been install	• People getting jobs and promoted because of association to higher level	• Waiting a long period for procurement to get what you want on site



**Question 5: What are your organizational challenges when planning preventative maintenance?**

• Lack of employees	• Lacking of training	• Leadership
• Responsibility of all staff	• Lacking of training	• Leadership
• Lack of management assistance	• Lacking of training	• Leadership
• Long waiting period for material	• Lacking of training	• Leadership
• Of pride doing a job well lack today	• Lacking of training	• Leadership
• Planning	• Lacking of training	• Leadership
• Lacking communication	• Lacking of training	• Leadership
• Lacking communication	• Lacking of training	• Leadership
• Lacking communication	• Lacking of training	• Leadership
• Lacking communication	• Lacking of training	• Leadership
• Job interaction	• Lacking of training	• I don't know
• Lacking of knowledge transfer	• Lacking of training	• I don't know
• sustainable of knowing how	• Lacking of training	• Template to full of DWS
• Lacking of expertise in specific dept.	• Lacking of training	• Lacking of SCM
• Lacking of O&M	• Lacking of training	• Leadership
• Work overload	• Leadership	• Leadership
• Leadership	• Leadership	



**Question 6: What are your **technical challenges** when planning preventative maintenance?**

• Lack of Communication	• Information system	• Shortage of engineers
• No Phone no PC	• Information system	• Lack of tool system
• Lack of machinery	• Information system	• Implementing technical tasks
• Lack of commitment	• Funding	• Formalization of SOP's
• Lack of research	• Funding	• Resources e.g. staffing
• Future development not taken into consideration	• Lack of outdated equipment and pass lifespan	• Lack of suitable technical qualified staff
• No plant design	• Lack of outdated equipment and pass lifespan	• No system in place services of pumps
• Lack of outdated equipment and pass lifespan	• Lack of outdated equipment and pass lifespan	• Shortage of vehicles
• Lack of SOP's	• Lack of outdated equipment and pass lifespan	• Performance plant assessments and condition assessments
• Lack of SOP's	• Information system	• Lack of technical equipment
• Lack of SOP's	• Lack of tools	• Technical training
• Lack of SOP's	• Lack of tools	• Outdated equipment
• Lack of Training	• Lack of tools	• Poor design maintenance
• Lack of Training	• Lack of tools	• Lack trainers
• Lack of Training	• Lack of tools	• Capacity of plant are limited
• Lack of Training	• Lack of tools	• Unplanned breakdowns
• Lack of Training	• Lack of tools	• Lack of equipment specification
• Lack of Training	• Capacity of plant are limited	• Using people without paying them
• Information system	• Capacity of plant are limited	• Capacity of plant are limited
• Information system	• Capacity of plant are limited	• Plant capacity
• Information system	• Capacity of plant are limited	





## Question 7: What are your **financial challenges** when planning preventative maintenance?

• Lacking of good Budget	• Lacking of good Budget	• Deviation from MFMA
• Lacking of good Budget	• Lacking of good Budget	• Tenders
• Lacking of good Budget	• Lacking of good Budget	• Management of cash flow a big problem
• Lacking of good Budget	• Lacking of good Budget	• Corruptions in the Municipality
• Lacking of good Budget	• Funding long term	• Cash flows
• Lacking of good Budget	• Sourcing sponsors	• Cash flows
• Lacking of good Budget	• Lacking of service of SCM	• Cash flows
• Lacking of good Budget	• Better pay will attract more people	• Cash flows
• Lacking of good Budget	• Timeous reporting	• Cash flows
• Lacking of good Budget	• Ring-fencing	• Cash flows
• Lacking of good Budget	• Economic Regulations	• No Guarantee creditors will pay on time
• Lacking of good Budget	• Corruptions in the work place	• People report always late for work, but get full pay
• Lacking of good Budget	• Understanding management	• Lacking of good Budget
• Lacking of good Budget	• Link OPS and Finance	• Lacking of good Budget
• Lacking of good Budget	• Construction challenges	• Lacking of good Budget
• Lacking of good Budget	• Lower priced services due to bribes	• Lacking of good Budget
• Lacking of good Budget	• Input from top management only when, budget are discussed	• Supply chain policy
• Lacking of good Budget	• Insufficient funds o fund projects	• Lacking of good Budget
• Lacking of good Budget	• cast analyses of new technology versus existing	• Supplier not getting paid on time
• Lacking of good Budget		