AUTHORITIES

1. DUTCH WATER AUTHORITIES

Advanced Level Design and Life Cycle Costing of Sustainable Water Management Infrastructures

Reader

16-8-2016

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PREFACE

2. INTRODUCTION

With the purpose of knowledge exchange and transfer, the Dutch Water Authorities have developed a 10 days training programme for Engineers and Policy Developers of the Bangladesh Water Development Board. The training is called Advanced Level Design and Life Cycle Costing of Sustainable Water Management Infrastructures.

This reader contains the curriculum, lesson plans, required preparations, assignments and presentations.

2.1. GENERAL DISCRIPTION OF THE TRAINING

The area of focus is Design and Life Cycle Costing for sustainable water systems including sluices, canals and embankments. The central question is: how to design, operate and maintain water system assets in such a way that an effective balance between performances (stakeholders requirements), risks and life cycle cost is obtained. The topic is approached from different angles: theory and practice on technical, managerial, institutional and financial aspects and stakeholder interests.

The learning targets of the training are specified in a request formulated by the Blue Gold project team (see paragraph 1.2). In the day-to-day training schedule the learning targets are linked to the presentations and field trips. Further, the participants will be asked to prepare specific questions, problems they encounter in Bangladesh or other issues from their own experience they wish to discuss during the training. These issues will be elaborated on during the first day and will get special attention during all lectures and field trips.

The training is a mixture of a theoretical approach and common practices in the Netherlands. Participants will have plenty of possibilities to ask for clarification and experiences from trainers, field personnel and stakeholders. A lot of time is reserved for reflection and translation of new information to the participants' own work environment. Two workshops are designed to practice risk based maintenance strategies and long term asset management planning on a water system case study.

Technical aspects of water systems and assets like different life cycles of components, will be dealt with. Field visits are planned to an equipment manufacturer, a dredging project and a high water protection program. Attention is given to the use of tools like life cycle costing and software for data analysis and water system modelling. During the training participants will work on their own group assignment. Based on their learning objectives they will gather information, analyse information and formulate their final results. These will be presented to a committee of experts who will provide immediate feedback. After the training the participants will have practical luggage and inspiration that will be of use in their regular work.

2.2. GENERAL OBJECTIVES OF THE TRAINING

The training is requested by the Blue Gold Programme. Blue Gold is a collaboration program between the Government of the Netherlands and the Government of Bangladesh. The program is implemented by the Ministry of Water Resources, through Bangladesh Water Development Board (BWDB, lead agency) and the Department of Agricultural Extension (DAE). Mott MacDonald's accompanies the Blue Gold Programme which is aimed at supporting communities to protect their land located in pol-

ders against floods from river and sea, to adapt to climate change, and to optimize the use of water resources for their productive sectors.

The objectives of the training are set by Blue Gold Team of the Bangladesh Water Development Board and read:

- Application of Life Cycle Design Concept to water management infrastructures (sluices, embankment and canals).
- Identification of infrastructure components having different life cycles.
- Operation and maintenance of different components and expected freedom of individual components.
- Design principles and methodology for designing and integrating these. Components considering life cycle cost.
- Responsibility, ownership, institutional, legal, technical and financial aspects O&M.
- Hands-on-exercise on the LCD and related software use, if any.
- Visiting some mechanical workshops to see fabrication of gates and hoists.
- Practical demonstration to show how the LCC &D are practiced in the NL.
- Field visit to see how actual O&M are planned, coordinated, financed and implemented in the NL.
 Observe beneficiary reactions and belongingness.
- Preparation of group report on the concept, principle and methodology of LCC & Design.
- Analysing potentiality of LCC&D in the context of O&M of polders in Bangladesh in Bangladesh.

| Date | Topic | Content | Lecturer | Location | Hotel |
|------------------------------|---------------------------------------|---|--|--------------------|--------------|
| Sept. 14 Morning | Introduction | Overview of the training, ex- pectations, learning objec- tives, explanation of the as- signment. | Assela Pathirana, (UNESCO-IHE) Michael Bentvelsen (Dutch Water Au- thorities), | Delft | Delft region |
| Sept. 14 <i>Afternoon</i> | Theory of LCC | Life cycle costing for engi- neers, making LCC decisions, Net present value, equivalent annual costs, etc. | Martine van den Boomen (Colibri Advies) | Delft | Delft region |
| Sept. 15 <i>Morning</i> | Design pro- cess | Role of engineering company, asset management incorpo- rated in the design process. | Rien Dam (Euro- Consult) | Delft | Delft region |
| Sept. 15 <i>Afternoon</i> | Design of In- stallations | Field trip KWT, manufacturer of valves, gates, etc. | Wim Vis (Water Authority Zui- derzeeland) | Bid- dinghuizen | Delft region |
| Sept. 16 <i>Full day</i> | Maintenance Planning Ex- ercise | Theory of LCC design, exer- cise. | Assela Pathirana <i>(</i> UNESCO-IHE) | Delft | Delft region |

2.3. CURRICULUM

| Date | Topic | Content | Lecturer | Location | Hotel |
|----------------------------|--|--|---|--------------------|-----------------------|
| Sept. 19 <i>Morning</i> | Planning O&M / instruments for asset man- agement | Legal instruments for mainte- nance (keur, legger), different types of tendering procedures. | Henne Ticheler, Wim Vis (Water Authority Zui- derzeeland) | Lelystad | |
| Sept. 19 Afternoon | O&M in prac- tice | field trip dredging company | Wim Vis (Water Authority Zui- derzeeland) | To be de- cided | transfer to Almelo |
| Sept. 20 Morning | Maintenance | Risk based maintenance, long term asset management plan- ning, development of a risk matrix, physical and functional decomposition of the water system. | Marcel van Zutphen (Water Authority Vechtstromen) | Almelo | Almelo re- gion |
| Sept. 20 Afternoon | Maintenance | Risk assessment using Failure Mode Effect and Criticality Analysis, making an LTAP. | Marcel van Zutphen (Water Authority Vechtstromen) | Almelo | Almelo re- gion |
| Sept. 21 Morning | Organisation & Roles | Dutch Water Authority and Water Management, Flood protection and Innovation | Myra Kremer, Eric Kuindersma (Water Authority Rivieren- land) | Tiel | |
| Sept. 21 Afternoon | | Field visit field visit to a dike reinforcement project | Myra Kremer, Eric Kuindersma (Water Authority Rivieren- land) | Tiel | Delft Region |
| Sept. 22 <i>Morning</i> | Prioritizing of investments | Prioritizing of investments. | Roland Boer (Water Authority Brabantse Delta | Delft | |
| Sept. 22 Afternoon | | Working on assignment | Michael Bentvelsen (Dutch Water Au- thorities), Assela Pathirana (UNESCO-IHE) | Delft | |
| Sept. 23 Morning | Design and Maintenance | Dutch Flood Protection Pro- gram: complex projects, in- spections, major overhauls, maintenance. | Henk Weijers (Wa- ter Authority Rijnland) | Leiden | |
| Sept. 23 Afternoon | Field trip | Wind mills for polder drainage / maintenance polder embank- ments | Henk Weijers (Wa- ter Authority Rijnland) | Leiden | |
| Sept. 26 <i>Morning</i> | Instruments | Use of software like GIS, SO- BEK | Frank den Heijer, Wouter Jan Klerk, (Deltares) | Delft | |
| Sept. 26 | Assignment | Working on assignment | In groups, inde- | Delft | Delft region |

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| Date | Topic | Content | Lecturer | Location | Hotel |
|-----------------------|-------------|---|--|----------|--------------|
| Afternoon | | | pendently. | | |
| Sept. 27 Morning | Assignment | Working on assignment | Michael Bentvelsen (Dutch Water Au- thorities), Assela Pathirana (UNESCO-IHE) | Delft | Delft region |
| Sept. 27 Afternoon | Conclusions | Presentations, conclusions, report, reflection, feedback and discussion of "lessons learned' translation to Bangla- desh situation. | Michael Bentvelsen, Assela Pathirana, Martine van den Boomen and other lecturers | Delft | Delft region |

2.4. PARTICIPANTS



3. PREPARATION

3.1. PERSONAL EXPECTATIONS

Please fill in the following table before the start of the training.

| Name: | |
|-------------------|--------------------------------------|
| Function: | |
| Organization: | |
| My expectations | of this training are: |
| | |
| | |
| | |
| My biggest chall | lenge in my work is: |
| | |
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| | |
| I would be really | content when this training gives me: |
| | |
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| | |
| What the Dutch | can learn from me is: |
| | |
| | |
| In five years Lwi | Il have achieved |
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3.2. ASSIGNMENT

Please read this assignment carefully and prepare yourself before the start of the training

Introduction

During the training Life Cycle Costing and Design for water management all elements of the design, operation and maintenance cycle of infrastructure will presented and discussed. Parallel to the presentations and field trips the participants will have to work on the assignment. During the training there will be 3 half days to work on these assignment and 1 half day to present the results.

Part 1 Preparation

The participants are requested to prepare for the course by collecting and bringing with them information (for example photos, costs, O&M requirements) on a local design/maintenance issue that they want to research through the course. During the training the participants will have to collect information, ideas and suggestions. At the last day of the training the participants will present possible solutions to these issues. They will also do so upon arrival in Dhaka to the Embassy of the Kingdom of the Netherlands.

During the first day of the training we will discuss the learning objectives. The participants will present their specific issues and we will discuss when and how during which parts of the training elements of these specific issues will get a place.

Part 2 Flow charts

The purpose of this assignment as a part of the training is that the participants learn to analyse the whole cycle and identify the role of the different actors and stakeholders: Design engineers, operators and maintenance engineers and of course the final beneficiaries of the infrastructure: the end-users who may be farmers, local communities, public governmental bodies. What is the role of manufactures, private design companies, and suppliers in improving the design of infrastructure? How can experiences during the operation and maintenance be translated to improve the original design? How can we define and optimize the total life cycle costs of infrastructure?

Participants are challenged to use their own experiences and the lessons learned during the presentations and field trips to formulate improvements of design process.

1. Make a work flow chart for the whole process of design, construction, operation and maintenance of mechanical and civil constructions used in water management in your country (or region). Think of irrigation/drainage canals, sluices or other constructions, embankments. Choose one process you think is most relevant.

Divide the whole process in unit steps and indicate for every step the following roles: who is the responsible person, actor (who is really doing something), who supporter of the activities, who needs to be consulted for advice, who needs to be informed. (RASCI). You can be as specific as you think you need to be.

Indicate who you consider the final beneficiary or user of the infrastructure (a group of farmers, a local community. Indicate per step who bears the costs (for salaries, material, energy) and what the money transactions are.

- 2. Make a comparable workflow for the Dutch situation. Use all presentations, field trips and other information (ask many questions) during the training course to construct this work flow chart. Choose a topic: mechanical equipment, embankments or drainage canals.
- 3. Make a list of possible improvements of both the work flow charts.
- 4. Answer the following questions:
 - a) How are innovations in the design of constructions, equipment or working methods realized?
 - b) How are experiences during the O & M phase used to improve the design?
 - c) What is the role of universities, public authorities, private companies in the process?
 - d) Do you think that the beneficiaries have enough influence on the process?
 - e) Indicate how the Plan Do Check Act cycle is implemented in the different steps of your work flow chart.
- 5. During the last day of the training, you will have to present the workflow chart and your conclusions in a power point presentation. You will be asked to explain the differences between the work flow process in the Netherlands and in your country, to present your evaluation and possible improvements. Note that there is not "one best solution". The choice of workflow process depends on local, national circumstances: physical, institutional, cultural, economic.

During the presentations will we discuss possible follow-up activities. How can we implement the lessons learned in daily practice? An example of a work flow process is given in attachment.

Here some details of the assignment:

- Your are given (online) support during this assignment. Progress meetings can be scheduled.
- You will be working in groups of 3-4, otherwise you will be pressed for time during the presentation day! Moreover, you stimulate discussion during the course of the preparation.
- In the program, there are several opportunities to work on this assignment. Please also use this time to read materials that was handed out in the classes, go over your notes, and write down your own thoughts and observations. This will be a good source of information once you're back home.

Expected from you is:

- preparation: collecting and bringing information (for example photos, costs, O&M requirements) on a local design/maintenance issue that you want to research through the course.
- an 10 page document and a PowerPoint presentation answering the (a) to (e) mentioned above
- a plan of implementation for when you are back in the office.

4. LESSON PLANS

Lesson plans that correspond with the curriculum in paragraph 1.3 are presented in the following paragraphs. The lesson plans contain requirements for preparation.

4.1. INTRODUCTION

| Title: | Introduction and Assignment | | |
|--|--|--|---|
| Date and time | September 14, 2016 from 9:00 - 12:00 | | |
| Location | IHE office in Delft | | ANT |
| Teacher(s): | Assela Pathirana, Michael Bentvelsen, | Assela Pathirana - Unesco IHE | Michaël Bentvelsen - Dutch Water Authorities |
| Contribution to Blue Gold Learn- ing Targets | Contributes to all targetsPreparation for assignment | | |
| Learning objec- tives | Identifying personal expectations and learn to analyse the whole cycle and and stakeholders | challenges identify the role of the o | lifferent actors |
| Description: | Overview of the training, expectations, leasing signment. | arning objectives, expla | nation of the as- |
| Didactical ap- proach | Plenary discussionsSelf presentationsWork groups | | |
| Preparation | Bring personal expectations (see para Reading paragraph 2.2: Assignment Collecting and bringing information (for quirements) on a local design/maintee through the course. | agraph 2.1) or example photos, cos nance issue that you w | ts, O&M re- ant to research |
| Literature | <u>http://www.kwtgroup.nl/main</u> | | |
| Short C.V. | Assela Pathirana is an associate Professor Management at Unesco IHE. In education Urban Drainage and Sewerage, Asset Ma transport and distribution, Water and Clim rently he supervises several PhD theses, of Urban Drainage, Asset Management a full CV see: <u>https://www.unesco-ihe.org/a</u> | or of Integrated Urban in he contributes to teac anagement of Water Ut nate and Computer Pro and mentors MSc rese nd Water Transport and ssela-pathirana | Water Cycle hing in areas of ilities, Water gramming. Cur- arch in the areas d Distribution. For |
| | Michaël Bentvelsen is a leading profession management. He is graduated from Wage treatment and microbiology, with addition the Rotterdam University in political scien designing and optimizing waste water treat | onal in waste water trea eniningen University in al courses in managem ce. He has over 25 yea atment plants, urban wa | tment and water Waste water hent skills, i.e. at ars' experience in ater manage- |

ment, water quality management, crisis management and water governance. He has been very closely involved in innovative projects in the Netherlands, both technically as well as institutional

4.2. LIFE CYCLE COSTING FOR ENGINEERS AND POLICY MAKERS

| Title: | Life Cycle Costing for Engineers and Policy Makers |
|--|---|
| Date and time | September 14, 2016 from 13:00 - 16:00 |
| Location | IHE office in Delft |
| Teacher(s): | Mrs. ir. Martine van den Boomen MBA - Colibri Advies / Delft University of Technology |
| Contribution to Blue Gold Learning Tar- gets | Identification of infrastructure components having different life cycles O&M of different components and expected freedom Lifetime of individual components; Design principles |
| Learning objectives | To understand the basic concept, use and applicability of life cycle costing (LCC) in the context of infrastructure asset management To compare mutually exclusive alternatives by using net present value (NPV) and equivalent annual cost (EAC) analysis To critically evaluate LCC outcomes by reviewing input values and boundary constraints |
| Description: | The objective of life cycle costing analysis is to support infrastructure asset management decision making based on the optimization of life cycle cost during the life cycle of infrastructure assets. Typical LCC questions are: Should we invest in this new project? Which design alternative is preferred based on life cycle costs? Should we replace or maintain this asset? How can we economically optimize operation & maintenance programmes? LCCA techniques are required to answer these types of questions. In the training we will cover the basic LCCA techniques which will enable the participants to solve frequently encountered LCC-challenges. Excel will be used for the LCC-calculations. The participants will practice in the training. Some common mistakes often found in LCC-calculations and how to avoid them, will be covered. |
| Didactical approach | Presentation of theory Exercises in class Discussing own practical LCC-challenges |
| Preparation | Bring a laptop with Excel to the training Bring a life cycle costing challenge of your own practice to the training |
| Literature | NIST Handbook 135 Life-Cycle Costing Manual for the Federal Energy Management Program, to be retrieved from: <u>http://wbdg.org/ccb/NIST/hdbk_135.pdf</u> |

Short C.V. Ir. Martine van den Boomen MBA is a senior consultant on Infrastructure Asset Management at Colibri Advies BV and a lecturer at the Delft University of Technology on reliability engineering and life cycle costing in the master of construction management and engineering. Besides educational experience, Mrs. van den Boomen has over 20 years of practical experience in the Dutch Water Sector.

4.3. THE ROLE OF AN ENGINEERING COMPANY

| Title: | The role of an engineering company: asset manage- |
|----------------------------|--|
| | ment incorporated in the design process |
| Date and time | September 15, 2016 from 9:00 - 12:00 |
| Location | IHE office in Delft |
| Teacher(s): | Dr. Rien Dam, EuroConsult |
| Contribution to Blue | Identification of life-cycle issues for infrastructure components in water |
| Gold Learning Tar- gets | sector; cross sectoral; experiences from Bangladesh |
| Learning objectives | • To understand the basic concept, use and applicability of life cycle costing |
| | (LCC) in the context of water infrastructure management |
| | Specific problems of water related infrastructure management in delta |
| | countries like The Netherlands and Bangladesh |
| | Role of consulting engineers |
| Description: | Identification of life-cycle issues for infrastructure components in water |
| | sector; cross sectoral; experiences from Bangladesh |
| | Infrastructure management and climate change |
| | Case Study Rotterdam |
| Didactical approach | Presentation of theory and context |
| | Discussing own practical LCC-challenges |
| Preparation | Bring a laptop with Excel to the training |
| | Prepare the life cycle costing for water related infrastructure from your |
| | own practice; to be presented and discussed |
| Literature | Several PDF's will be handed out during the course (digital copies) |
| Short C.V. | Dr. Rien Dam (1961, The Netherlands) is an experienced international tech- |
| | nical assistance expert with a solid basis in IWRM, environmental geosciences |
| | and hydrogeology. He has broad experience in multiple countries in Asia and |
| | Africa working as a senior project expert on urban and regional water man- |
| | agement issues, flood risk studies, water resources management, water de- |
| | mand/supply studies, climate change adaptation and natural resources man- |
| | agement. He has worked extensively with government organisations, |
| | knowledge sector (universities) and the private sector (consulting, technology- |
| | IT companies and start-up companies). |



4.4. FIELD TRIP TO KWT, MANUFACTURER OF VALVES, GATES, ETC.

| Title: | Field trip to KWT, a manufacturer of valves, gates, etc |
|----------------------|--|
| Date and time | September 15, 2016 from 13:00 - 16:00 |
| Location | Biddinghuizen |
| Teacher(s): | Mr. Wim Vis, Water Authority Zuiderzeeland |
| Contribution to Blue | Materials having different life cycles |
| Gold Learning Tar- | Lifetime of individual components; |
| gets | Design principles |
| | Innovative solutions |
| Learning objectives | To learn from experiences of others |
| | To learn about innovative solutions |
| Description: | The KWT companies stand for daring and innovative product design, a world- wide strong and trusted image, and a proven product quality. For sewerage, pumping stations or flow regulation alike. All products are made from high grades of Stainless Steel 304L or 316L, often in combination with chemically inert High Density Poly Ethylene (HDPE). |
| Didactical approach | Field visit |
| Preparation | None |
| Literature | <u>http://www.kwtgroup.nl/main</u> |
| Short C.V. | Ing. W.Vis is senior project leader within Water Authority Zuiderzeeland. He is educated in civil engineering projects and specialised in: solutions of water problems. water systems, sewage systems., air pipe drains, weirs systems. and dredged systems. |

4.5. PLANNING OF OPERATION & MAINTENANCE AND INSTRU-MENTS FOR ASSET MANAGEMENT

| Title: | Planning of Operation and Mainte- nance in the context of Asset Management | | |
|--|--|--|---|
| Date and time | September 19, 2016 from 9:00 - 12:00 | 627 | 00 |
| Location | Water Authority Zuiderzeeland - Le- lystad | | A calification |
| Teacher(s): | ir. Henne Ticheler and ing. Wim Vis | Henne Ticheler - Water Authority Zuiderzeeland | Wim Vis - Water Authority Zui- derzeeland |
| Contribution to Blue Gold Learning Tar- gets | The legal and policy framework for operation and maintenance (Dutch: keur/ledger/WBP). Tendering procedures: frequency versus quality tendering. Identification of asset instruments | | |

| | Materials having different life cycles |
|---------------------|--|
| | Lifetime of individual components; |
| | Design principles |
| Learning objectives | • To understand the multi annual planning process as a way to be in control |
| | of water system management. |
| | • Understanding of the tools being used in managing the water system. |
| | • To understand the basic concept of life cycle costing (LCC) in the context |
| | of infrastructure asset management. |
| Description: | Zuiderzeeland is managing a water system of hundreds of km's of canals and |
| | The area is simply too yest and the number of courses and similar two is too. |
| | The area is simply too vast and the number of canals and civil structures is too |
| | large to manage effectively without a management support system. The water |
| | Authority Zuiderzeeland adopted a multi annual planning system in order to be |
| | in control of managing the water system. |
| | This training will cover the following aspects: |
| | • The legal and policy framework in which the planning system operates. |
| | • The planning process: from budget based maintenance to asset condition |
| | budgeting. |
| | Tools being used in the planning process. |
| | Costing of maintenance. |
| | Work processes and the management dashboard. |
| | Limitations of the system. |
| | Future developments. |
| | • the use of materials which can create extra value for a company. |
| | The choice of using materials is important for live costing. |
| Didactical approach | Presentation of a practical example of how asset management is imple- |
| | mented in water system management at the Water Authority Zuiderzee- |
| | land. |
| | Discussing planning challenges in your own context. |
| Preparation | Bring your own planning challenges to the training |
| | Bring a asset product as example of your own practice to the training |
| Literature | Van Steen, P.J.M. & Pellenbarg, P.H Water Management Challenges in |
| | the Netherlands. Retreived from: |
| | https://www.rug.nl/staff/p.h.pellenbarg/artikelen/publicaties/28water_man |
| | agement_challenges_in_the_netherlands.pdf |
| Short C.V. | Ing. W.Vis is senior project leader within Water Authority Zuiderzeeland. He is |
| | educatated in civil engineering projects and specialised in: solutions of water |
| | problems. water systems, sewage systems., air pipe drains, weirs systems. |
| | and dredged systems. |
| | In Lieppe Tickeler is a policy advisor in the planning addies in the department |
| | in menine incherer is a policy advisor in the planning section in the department |
| | or water system management. Besides working for hearly 10 years in the pub- |
| | in sector on water management, IVIR. Licheler worked & years for a leading |
| | consultancy company in The Netherlands and also worked in Africa for 5 |
| | years. Mr. Licheler took his MSc at the Wageningen University. |

4.6. FIELD TRIP TO A DREDGING COMPANY

| Title: | Field trip dredging company |
|------------------------------|--|
| Date and time | September 19, 2016 from 13:00 - 16:00 |
| Location | To determine |
| Teacher(s): | Mr. Wim Vis and colleague |
| Visiting dredging company | To see the differences between dredging systems in practice |
| Learning objectives | To understand the basic concept of dredging |
| Description: | There are difference systems of dredging. This dispense of the local situation. The quantity of mud the accessibility of the location the applicability of the mud |
| Didactical approach | awareness about the value of mud understanding of the different systems of dredging understanding how to use the different systems of dredging |
| Preparation | None |
| Literature | None |
| Short C.V. | Ing. W.Vis is senior project leader within Water Authority Zuiderzeeland. He is educated in civil engineering projects and specialised in: solutions of water problems. water systems, sewage systems., air pipe drains, weirs systems. and dredged systems. |

4.7. RISK BASED MAINTENANCE, FMECA, LTAP

| Title: | Risk matrix, Failure Mode Effect and Criticality Analysis, long term asset management planning. | |
|---------------|---|-------|
| Date and time | September 20, 2016 from 9:00 - 12:00 and 13.00 – 16.00 | |
| Location | Water Authority Vechtstromen in Almelo | hanad |
| Teacher: | Marcel van Zutphen - Water Authority Vechtstromen | |

| | Language and the second se |
|-----------------|--|
| Contribution to | O &M of different components |
| Blue Gold | expected freedom/lifetime of individual components |
| Learning Tar- | design principles and methodology |
| gets | |
| Learning ob- | • To understand the basic concept, use and applicability of risk based mainte- |
| jectives | nance in the context of infrastructure asset management. |
| | • To understand the basic of using Failure Mode Effect and Criticality Analysis in |
| | the context of infrastructure asset management. |
| | • To understand the basic concept of long term asset planning in the context of |
| | infrastructure asset management. |
| Description: | The objective of Risk Based maintenance is to support infrastructure asset manage- |

| | ment decision making based on the optimization of maintenance during the life cycle of infrastructure assets. Typical risk based questions are: |
|----------------|--|
| | • What is going wrong when we do nothing? |
| | What is going wrong writen we do nothing? |
| | What is the consequents on a failure? What are the company values, what is really important |
| | • what are the company values, what is really important. |
| | How can we make a long term schedule for operation & maintenance pro- grammes? |
| | Risk based maintenance techniques are required to answer these types of questions. |
| | In the training we will cover the basic FMECA techniques which will enable the partic- |
| | ipants to solve frequently encountered maintenance-challenges. Word will be used |
| | for the personal notes. The participants will practice in the training. |
| Didactical ap- | Presentation of theory |
| proach | Exercises in class |
| | Discussing own practical maintenance-challenges |
| Preparation | Bring a laptop with Word to the training |
| · | Bring a Maintenance challenge of your own practice to the training |
| Literature | Sydney Water (2010). Procedure for Failure Mode Effects and Criticality Analysis |
| | (FMECA) retreived from: |
| | https://www.sydneywater.com.au/web/groups/publicwebcontent/documents/docu |
| | ment/zgrf/mdg2/~edisp/dd 046414.pdf |
| | APPENDIX 35-A FAILURE MODE & EFFECTS ANALYSIS (FMEA) retrieved |
| | from: |
| | https://www.ceaa- |
| | acee.gc.ca/050/documents staticpost/49262/89282/Chapter 35 Appendices/Ap |
| | pendix 35-A FMEA Summary Table for October 2009 Workshop.pdf |
| Short C.V. | ing. Marcel van Zutphen MSc is a senior advisor on Infrastructure Asset Manage- |
| | ment at Water Authority Vechtstromen and a lecturer at stichting Wateropleidingen. |
| | Besides educational experience, Marcel van Zutphen has over 25 years of practical |
| | experience in the Dutch Water Sector. |

4.8. DUTCH WATER AUTHORITY AND WATER MANAGEMENT, FLOOD PROTECTION AND INNOVATION

| Title: | Dutch Water Authority and Water Management, Flood protection and Innovation |
|--|--|
| Date and time | September 21, 2016 from 10:00 - 16:00 |
| Location | Water Authority Rivierenland in Tiel |
| Teachers: | Mr. Eric Kuindersma and Mrs. Myra Kre- mer - Water Authority Rivierenland |
| Contribution to Blue Gold Learn- ing Targets | Identification of the role of the Dutch Water Authority in Dutch Water Manage- ment: responsibility, ownership, institutional, legal, technical and financial as- pects. Organization of Flood Protection in the Netherlands. |
| Learning objec- tives | To understand the way how Water Management is organised in the Nether- lands and specifically the role of the Water Authority. |

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| | To get an insight in how a dike reinforcement project is developed and which new techniques are being used. To have an open mind in developing new ways of organising your project. |
|--------------------------|--|
| Description: | There is a national Flood Protection Program in which all dike reinforcement pro- jects for the near future are planned. The way how these projects are executed is up to the Water Authority. As the objective of this national program is to execute all these projects in a faster, better and cheaper way than before, there is a focus on new ways how to realise this. |
| | In the training we will start with an introduction on the organisation of water man- agement in the Netherlands, tasks and responsibilities of water authorities in general and Water Authority Rivierenland specifically (including governance and financial aspects). We continue with a presentation on flood protection and dike reinforcements, including planning, organisation and financial aspects. Also inno- vative approaches in flood protection are part of the training. We will end the training with a field visit to a dike reinforcement project. |
| Didactical ap- proach | Presentation of theory Interactive presentation Visit Central Control Room Field visit |
| Preparation | Bring an open mind to the training |
| Literature | <u>https://www.ruimtevoorderivier.nl/english/</u> RWS and Unesco-IHE (2013). Tailor made collaboration. A clever combination of process and content. Retrieved from: <u>https://www.unesco-ihe.org/sites/default/files/13270-rvdr-brochure-governance-engels_def-pdf-a.pdf</u> |
| Short C.V. | Eric Kuindersma is International affairs officer at Water Authority Rivierenland and Senior Policy Advisor Water Governance at the Dutch Water Authorities and has 25 years of experience in the Dutch water sector. He is involved in several international cooperation projects and is an experienced speaker and orator for international groups on the subject organisation of water management in The Netherlands |
| | Myra Kremer MSc is a senior strategical and policy advisor in water management at the Water Authority Rivierenland and before at the Ministry of Infrastructure and Environment. After her education on the South Bank University in London and in the Netherlands she has about 20 years of experience in the Dutch Water Sector. |

4.9. PRIORITIZING OF INVESTMENTS

| Title: | Prioritising of Investments |
|-----------------|--|
| Date and time | September 22, 2016 from 9:00 - 12:00 |
| Location | IHE office in Delft |
| Teacher(s): | Roland Boer - Water Authority Brabantse Delta |
| Contribution to | Application of Life Cycle Design Concept to water management infrastructures |
| Blue Gold | (sluices, embankment and canals) |
| Learning Tar- | Hands-on-exercise on the LCD and related software use, if any |
| gets | Design principles |
| Learning objec- | • To understand the basic concept, use and applicability of company values for |
| tives | decision making in infrastructure asset management |
| | • A way of prioritising Investments in combination with risk management (and life |
| | cycle costing) |
| | To evaluate the different outcomes from the participants |
| Description: | The objective prioritising of investments is to support infrastructure asset manage- |
| | ment decision making based on the principle "most value for money." |
| | Subjects are: |
| | |
| | What elements cause different outcomes? |
| | How can you organize that? |
| | What if values change? |
| | Risk management |
| | The training covers the basic concept of prioritising investments which will enable the participants to solve prioritising challenges in a pragmatic way. In the training we will practice with cases to make your own prioritising outcome. This we will dis- cuss plenary. Excel will be used for the practice. |
| Didactical ap- | Presentation of theory |
| proach | Exercises in class with Excel model and cases |
| | Discussing of own practical choices and outcomes |
| | Understanding how to come to better results |
| Preparation | Bring a laptop with Excel to the training (at least excel 2010) |
| Literature | Gosenheimer, C. (2012). Project Prioritization. A structured approach to work- |
| | ing on what matters most. Office of Quality Improvement University of Wiscon- |
| | sin System Board of Regents. Retrieved from: |
| | http://oqi.wisc.edu/resourcelibrary/uploads/resources/Project_Prioritization_Gui |
| | <u>de_v_1.pdf</u> |
| Short C.V. | Roland Boer is working at Water Authority Brabantse Delta as a consultant asset |
| | management. He lectures colleagues on the asset management principles to pre- |
| | pare them tor their role. Therefore, Roland knows a lot about the basics of asset |
| | management. |
| | Roland was responsible for bringing asset management to life at the Water Authori- |
| | ty. |

4.10. DESIGN AND MAINTENANCE PROJECTS FOR ENGINEERS AND POLICY MAKERS

| Title: | Maintenance projects for engineers and policy mak- ers | ALL PARA |
|----------------------|--|---|
| Date and time | September 23, 2016 from 9:00 - 12:00 | |
| Location | Rijnlandhuis, Archimedesweg 1, Leiden | Henk Weijers - |
| | | Motor Authority |
| | | Riinland |
| Teacher(s): | drs. ing. Henk Weijers, project manager IJsseldijk Goud Niek Oortman MSc., project manager Regional Embani Philip Pijnnaken, maintenance engineer and 'molenaar' Optional: welcome and introduction by Gerard Doornbook | da kments (miller) <mark>s (chairman</mark> |
| Contribution to Plug | Rijilialiu) | acomont infractrue |
| Gold Learning Tar- | Application of Life Cycle Design Concept to water mana tures. Identification of infrastructure components having differ Operation and maintenance of different components an | agement infrastruc- ent life cycles. d expected freedom |
| | of individual components. Design principles and methodology for designing and ir components considering life cycle cost. Responsibility, ownership, institutional, legal, technical pacts Q&M | ntegrating these. and financial as- |
| Learning objectives | Understand the concept of the high water protection systematics, multiple levels of high water protection (primary a bankments). Understanding of the concept and initiation of maintenal operational responsibility (practical Risk Based Mainter Dealing with local stakeholders in civil infrastructure processes). Water level control with windmills – risks in maintenance assets. Financing of maintenance projects in a Water Authority Life Cycle Design of revetments and windmills – maintenance | stem in the Nether- and secondary em- nce projects and nance, RBM). ojects. e and operation of |
| Description | Life Cycle Design of revenents and windmins – maintee | enance planning |
| Description: | The objective of maintenance projects is to keep infrastruct state. To decide what is acceptable, it is necessary to set a risk (norm). Often, various alternatives are possible to compling the training, it is explained what the risk level is of: High water protection by primary and secondary embar The drainage system water level control in polders by w Maintenance of the embankments is required because of: Land subsidence (raising of embankments, improving s | tability), |
| | Life cycle of revetments (grass, stone)/embankments,Repair of damage by external causes. | |

| | In the Netherlands, windmills are used already for hundreds of years. It will be explained how these mechanical assets are kept in shape by replacing various parts in: |
|---------------------|---|
| | Large scale maintenance (foundations, civil structure), Normal maintenance (replacement of rotating parts such as the sails, pump, etc.), |
| Dite Colored | Daily maintenance. |
| Didactical approach | Presentation of theory and cases Discussing comparability of the assets in the Dutch and Bangladesh situa- tion |
| Preparation | Bring a life cycle costing challenge of your own practice to the training |
| Literature | Flood control in the Netherlands. To be retreived from: http://www.riinland.net/overig/english and |
| | <u>http://www.rijnland.net/downloads/floodcontrolrijnland-1-1.pdf</u> Cultural Heritage Agency, May 2014. Man-made lowlands. A future for an- |
| | cient dikes in the Netherlands. To be retreived from: <u>http://cultureelerfgoed.nl/sites/default/files/publications/man-made-</u> lowlands.pdf |
| | Optional book: Van de Ven, G.P. Man-made lowlands. History of water management and land reclamation in the Netherlands |
| Short C.V. | Mr. Henk Weijers is a civil engineer and political scientist. He has worked on the high water protection of Bangkok and St. Petersburg. As the asset manager of Water Authority Rijnland, he visited the Khulna area in January 2015 to define the possibilities of co-operation between Dutch Water Authorities and the Blue Gold Program. At the moment, he is project manager of the improvement of a primary embankment in the city of Gouda. |
| | Mr. Niek Oortman is project manager on the improvement of secondary em- bankments in het Rijnland area. He is involved in asset management in prioritiz- ing the secondary embankments. Also, Niek is the contract manager of a pro- ject on the improvement of the water management and infrastructure of several polders in the Rijnland area. |

Mr. Philip Pijnnaken is maintenance expert, working on various maintenance projects on the installations of Rijnland (pumping stations, windmills, sewerage treatment, etc.)



4.11. FIELD TRIP: WIND MILLS FOR POLDER DRAINAGE / MAINTE-NANCE POLDER EMBANKMENTS

| Title: | Field trip: windmills for polder drainage / maintenance polder embank- | |
|----------------------|--|--|
| | ments | |
| Date and time | September 23, 2016 from 13:30 – 16:30 | |
| Location | Molenviergang Aarlanderveen | |
| | (Dutch: http://www.molenviergangaarlanderveen.nl/) | |
| Teacher(s): | Mr. Bert Splinter, chairman of the molenviergang foundation | |
| | Mr. Luc Verbij, building advisor; Verbij Hoogmade BV | |
| Contribution to Blue | Field visit to see how actual O&M are planned, coordinated, financed and | |
| Gold Learning Tar- | implemented in the NL. Observe beneficiary reactions and belongingness. | |
| gets | Practical demonstration to show how the LCC &D are practiced in the NL | |
| | Visiting some mechanical workshops to see fabrication of gates and | |
| | hoists. | |
| Learning objectives | Experience maintenance projects working | |
| Description: | Mr. Verbij will give a presentation on the wind mill concepts. | |
| Didactical approach | Presentation of solutions | |
| | • Field trip: walking and talking while viewing the wind mills and embank- | |
| | ments | |
| | Discussing usability for the Bangladesh situation. | |
| Preparation | None | |
| Literature | Wind Power Prospects in Bangladesh, A. Hasib Chowdhury PhD, Dept. of | |
| | EEE, Bangladesh University of Engineering and Technology, September | |
| | 2012. To be retrieved from: | |
| | http://www.academia.edu/4024139/Prospects_of_Wind_Energy_in_Bangla | |
| | desh_Dr_Abdul_Hasib_Chowdhury_Bangladesh_University_of_Engineeri | |
| | ng_and_Technology | |
| Short C.V. | Bert Splinter is chairman of the 'molenviergang' foundation | |
| | Luc Verbij is director of Verbij Hoogmade BV, an engineering and con- | |
| | struction agency for traditional windmills. | |
| MOLEN 3 MOLEN 2 | MOLEN 1 MOLEN 1 | |

4.1. USE OF MODELS FOR SUPPORTING ASSET MANAGEMENT DECI-SIONS

| Title: | Use of models for supporting asset management decisions |
|----------------------------|---|
| Date and time | September 26, 2016 from 9:00 - 12:00 |
| Location | Delft O O O |
| Teacher(s): | Mr. Wouter Jan Klerk - Deltares |
| Contribution to Blue | Application of LC&D methods for specific types of water infrastructures, illus- |
| Gold Learning Tar- gets | trated by the use of models. |
| Learning objectives | Understand how to relate model output of specific models to general Life Cycle Design concepts. Understand when to use which model at which level of detail. Understand the influence of data-scarcity on potential of model use. |
| Description: | The performance of water infrastructure changes over time. As water infrastructure is often located in larger systems with complex physical behaviour, designs have to be evaluated by use of hydrodynamic and sediment models such as Sobek or Delft3D. In this training it is discussed how to use models which give output for a single situation in a life-cycle context. It is also discussed how data-scarcity influences model results, and how models can still be used in a data-scarce environment. The set-up of the training is as follows: Basic concepts of performance of water infrastructure on an object and a system level. Illustration of the potential use of models in life-cycle design questions for water infrastructure using practical cases based on past projects in the Netherlands. Interactive discussion on how models can aid in solving actual problems in Bangladesh |
| Didactical approach | Presentation of theory Presentation of practical cases in the Netherlands Discussion on a selection of cases from Bangladesh |
| Preparation | Bring a challenge from your own practice where aspects such as complex physical behaviour, design challenges and data-scarcity come together. |
| Literature | • tbd |
| Short C.V. | Wouter Jan Klerk is working as an advisor/researcher at research institute Del- tares on the topics of flood risk and asset management. He has been working on connecting state-of-the-art models for, for instance, failure of revetments and behaviour of water systems to general techniques for life-cycle costing and investment planning. |

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5. PRESENTATIONS