



Preventive Maintenance for Water Utilities

Progress

Public Part

Project information

Project acronym: PM4WAT
Project title: Preventive Maintenance for Water Utilities
Project number: 502419-LLP-1-2009-1-GR-LEONARDO-LMP
Sub-programme or KA: Leonardo da Vinci Multilateral Projects
Project website: <http://www.teg.cti.gr/pm4wat/>

Reporting period: From 01/11/09
To 30/11/10

Report version: 1
Date of preparation: 20/11/10

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This project has been funded with support from the European Commission.

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Executive Summary

The main objective of the project is to develop an e-learning platform and courseware on Preventive Maintenance (PM) of the water distribution network for vocational training of water utility operational staff.

Target audience:

Utility maintenance personnel, inspection engineers and hydraulic engineers in water utilities. Public, private organizations and decision makers in the water sector. VET providers who offer training in water resources and management.

Project objectives:

Transfer state of the art PM methodologies and practices to personnel of urban water utility networks from domain experts. Develop a simulation platform that will advise trainees on the reliability and operational scenarios of urban water networks. Provide training on pro-active rehabilitation and on the effects of natural hazards on the network. Develop courseware for web-based and off-line training on PM, available in four languages (English, Greek, Turkish and Italian).

Participants involved:

The Consortium comprises seven organisations from four Mediterranean European countries, all of which face similar problems with water resources and distribution. The Consortium includes universities and research institutions, ICT organization, VET providers and urban utility networks with complementary knowledge and experience in the field. The partners provide the scientific knowledge, development of tools and methodology in teaching and training, validation of courseware and tools, deployment and integration of the results of the project. The Consortium has been augmented with a large number of contributing/associate partners who cooperate closely in all phases of the project – contributing with national know-how and disseminating our project. The contributing partners include universities, VET providers, water utilities and SMEs involved in the water sector.

Approaches used:

The proposed VET program involves **a theoretical part**, which includes web-based courseware that covers the basic principles of PM, its benefits, limitations, organizational aspects, and **a practical part**, which involves a software system that integrates a GIS, Reliability Analysis and Database Queries to compute how ageing and natural hazards affect the reliability of a network under different environmental conditions.

Major results/products achieved:

A state of the art survey of current practices in maintenance of water utility networks has been completed. A prototype of the e-learning platform and a significant part of the proposed courseware has been implemented. The training simulator is nearing completion. Topological information and data on three utility networks has been acquired and is being processed to populate the corresponding system databases.

Plans and prospects for the second year of the project:

Completion of the end-products, pilot training with target groups, organisation of the final conference, further dissemination and exploitation of the project results.

Details of the project website:

The project website <http://teg.cti.gr/pm4wat> provides information on activities, leaflets and news on the project.

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1. Project Objectives

The main objective of the project is to develop an e-learning platform and courseware on Preventive Maintenance (PM) of the water distribution network for the vocational training of water utility operatives and to instruct them how to increase the reliability of the network, decrease disruption of service and save valuable water resources. The project is especially useful for water utility maintenance personnel in earthquake-prone regions. National experiences and practices have been amassed to generate a unified curriculum and a library of learning content. In more details the project objectives are:

- to transfer state of the art preventive maintenance methodologies and practices to personnel of urban water utility networks from domain experts from the participating countries
- to develop a simulation platform that will advise the trainee on the reliability of the overall network and examine various 'what-if' scenarios
- to provide training on pro-active rehabilitation and on the effects of natural hazards
- to develop courseware for web-based and off-line training on preventive maintenance of urban utility networks, translated into the four languages of the participating countries.

Most public water utilities carry out maintenance only when a breakdown occurs. This logic dictates that it costs more to regularly schedule downtime and maintenance than it would cost to operate the network until breakdown at which repair or replacement becomes imperative. Unreliable service and customer dissatisfaction are inevitable, as are the significant water losses of valuable resources due to leakage or pipe rupture.

The reliability of an urban water distribution network can be improved significantly by adopting a systematic proactive strategy for replacement of worn components. This is the essence of PM, i.e. a schedule of planned maintenance actions aimed at prevention of breakdowns and major failures. The primary goal of PM is thus to prevent the failure of components of the network before they actually occur. To take full advantage of this, the utilities must have an accurate topological image of the network, the age and type of materials used in its various branches and past maintenance records.

The target group concerned is principally utility maintenance personnel, inspection engineers and hydraulic engineers in public water utilities. It becomes imperative today to train maintenance personnel in state of the art PM and take advantage of the new methodologies for assessing the condition health and reliability of a municipal water utility network. The VET course level will differ for each group. Within the life of the project pilot training groups from participating partners will be trained on the proposed system with a view to further diffusion in other water utilities.

2. Project Approach

The project started with a State of the Art survey on current national practices in maintenance of water utility networks in the participating countries. During this phase a number contributing partners from Italy, Finland and the Netherlands (ATO3 Marche, ANCE Abruzzo, Università politecnica delle Marche, Van der Meer & van Tilburg Innovation, Vitens water supply Co., ECO-ONE Finland, Sykli Environmental school of Finland) were invited to join the consortium and they in turn contributed equally to the composition of the review by appending the state of the art in their respective countries. The survey has a European added value from the organizational and pedagogical points of view for the development of the proposed curriculum.

The objective of this survey was to make recommendations on the essential content of the courseware that would be developed for the preventive maintenance of urban water networks as well as define the principal topics that should be covered in the proposed curriculum. During this phase the knowledge and experience of all the partners, both principal and contributing, was distilled and integrated into a single document which formed the first deliverable of the project. It became obvious that a number of diverse methodologies of varying levels of sophistication were being used for water network maintenance. It also became apparent that there was a degree of commonality in procedures and terminology which formed the basis of the concerted effort that followed.

Following this survey, partners undertook the tasks of defining the specifications for the e-platform on which the PM courseware would be made available. There followed the design and implementation of the e-platform on MOODLE. Similar steps were followed for the development of the training simulator which would accompany the courseware. The simulator was based on an earlier EU funded project "SEISLINES" which was re-designed and adapted for the purposes of this project. The training simulator uses real geographical information on the topology of the water utility networks as well as real data on the properties of the elements in the branches of the network. Pertinent information is made available from water utilities in three countries participating in this project (Greece, Italy and Turkey).

In parallel, a significant part of the courseware was developed by the thematic experts of the consortium who pooled their knowledge and expertise in a series of chapters on Urban Water Supply Networks, Network Mapping, System Hydraulic Modeling and Analysis, System Performance Assessment, Criteria and Objectives, Technical and Social Options as well as Good Practices in maintenance. The chapters are written primarily with the pedagogical impact for VET of the course material.

To ensure the quality and satisfactory work progress in accordance with the project time plan, a Quality Assurance Plan was established from the beginning of the project for review and evaluation of the working methods and outcomes of the project, following closely the Management Plan which was also established at the outset of the project. A number of templates and questionnaires were prepared and used to review and evaluate the partner meetings, deliverables as well as the project progress during the reporting period. The internal evaluation results are important so as to keep close track of the progress made in the project.

Partner agreements were drawn up and duly signed. These agreements also provide a mechanism for assessing the work performed by the partner and that the funding conforms to this progress.

A Dissemination Plan of the project results was also prepared at the beginning of the project and outlined the activities and products that must be developed in order to best publicize the project in the form of a multilingual project website (www.teg.cti.gr/pm4wat), leaflets and posters to be made available to as wide an audience as possible. Links to the project website have been added to the websites of all the participating partners. A News feature, which informs the visitor of meetings, ongoing development and dissemination activities has also been included in the project website. In addition, presentations on the project have been made at technical and LLP meetings and documentation has been disseminated at relevant events in Italy, Greece and Turkey as well as in the INFODAYS 2011 meeting in Brussels in November 2010. The project has been posted in the ADAM portal <http://www.adam-europe.eu> and the project website <http://www.teg.cti.gr/pm4wat> has already received 2600 visits in the first year from a host of countries. The major event of the project will be the Final Conference which will take place in Athens in September 2011 at which the results of the project will be presented in a series of presentations. These will also appear in the form of conference proceedings.

After the first six months an Exploitation Plan was drawn up that sets out the guidelines and proposed actions for maximum diffusion of the project results during the course of the project and after its completion - sustainability. To this end it is the intention of the consortium to offer the end-products of the project at no cost and no licence fee to any water utility or academic institutions which requests it, under "creative commons" license. This assures sustainability of the product results for a long period of time, following successful termination of the project.

3. Project Outcomes & Results

The following planned **outcomes and results** have been achieved during the reporting period – Nov 1st, 2009 – Oct. 30th 2010:

Report on Current National Practices and Curriculum Principles Definitions

This product satisfies the objective stated at the outset of the project. The initial and very basic task of the project was to assess and record the current national practices on maintenance of water utility networks. Principles and rules were reported and exchanged between the partners and a comparative study made. It was an important outcome of this phase was to register the similarities in practices and the advances that have already been implemented in some of the countries involved. In addition to the partners in Greece, Italy, Turkey and Cyprus, the consortium was enhanced by a number of contributing partners in other European countries whose participation proved invaluable. Consequently, this report contains also material submitted by these contributing partners who report on maintenance procedures in other regions in Italy, as well as in Finland and the Netherlands.

The content of the current national practices reports included the following:

1. Basic information of the City and the Water Utility Network
2. Water Utility Company Profile
3. Water Consumption
4. Water Quality Issues
5. Current Maintenance Practices
6. Concluding Remarks and Recommendations

An outcome of this intensive cooperation was the development of a curriculum definition on a unified methodology on preventive maintenance of the water distribution networks.

Report on Specifications of the Training Methodology

This report defines the formal specifications for the courseware. Special attention has been given to formal specification of the course model and of the web-based e-learning environment as well as standards for the e-content of the courseware.

Report on Platform Specifications and Design

This report describes the specification and design of the e-learning platform for the training of the personnel of urban water distribution networks on PM. MOODLE which is a widely adopted environment for e-learning (open source software), has been selected as the platform.

Report on Specifications and Design of the Training Simulator

This report provides an outline of the original integrated system that was developed in the SEISLINES (“Age-Variant Seismic Structural Reliability of Existing Underground Water Pipelines”) project on which the Training Simulator of the project is based. The report also outlines the improvements and upgrades that have been necessary to improve the performance of the original system and make it customisable and user-friendly.

Although these reports are not available to the general public, they nevertheless place the foundations for satisfying the stated project objectives.

e-learning platform and pilot courseware

Based on the foregoing specifications and design, the shell of the e-learning platform has been implemented and allows for ready seeding of the courseware. In order to test the platform, pilot courseware consisting of a few chapters (Chapters 2 and 3 out of total of 9) has already been seeded and available for prototype testing. The pilot courseware, we note, is ahead of schedule and reason for advancement of the work package on Development of the Courseware.

The fact that a prototype has been made available three months ahead of schedule has given all partners the opportunity to comment and improve the platform and courseware structure. Thus, more graphical information which greatly improves the comprehension of the material is now included as has the structure of the question and answer procedure (quizzes). Each chapter or module follows the standard of modularity and units of learning. The remaining courseware is in the final stages of preparation and inclusion in the platform, to be completed by the end of 2010.

Training simulator

The training simulator based on the SEISLINES project is nearing completion (completed by 70%). Topological information and data on three utility networks from Italy, Cyprus and Turkey have been acquired and are being processed to populate the corresponding system databases.

Project website www.teq.cti.gr/pm4wat

The project website was made available from the outset of the project and is continuously updated as the project evolves. The site has two sections: one for the public which includes general information about the project, partner description and contacts, project objectives, the work packages as well as news and public events, public documents e.g. multi-lingual leaflets, presentations of e-learning organisations, EACEA publications etc. and links related to relevant projects and work on PM. The public view serves as a **dissemination** tool and is available in four languages of the participating partners, i.e. English, Italian, Greek and Turkish.

The second section allows access only to the partners of the project under password and it is a repository of all technical documents and reports generated in the project, Minutes of Meetings, Contractual Documents, Partner Agreements and a photo library of meetings and partners. This facility allows for direct uploading and downloading of all pertinent documents, thus simplifying the interchange of information between partners. The second section is also available to Contributing Partners who have the same access rights as the principal partners.

Project Leaflet and Poster

The project leaflet and poster for the project were designed in English. The leaflet is also translated into all the languages of the partnership. Initially 600 copies of the English leaflet were produced and distributed to the partners, contributing partners and EACEA for the INFODAYS 2011 event in November 15, 2010. In addition to the leaflets in English, an adequate number of copies in the other languages has been produced for local dissemination to other water utilities, public bodies, technical meetings and events. It is anticipated that as the project evolves, there will be a need for more copies to be produced and disseminated, especially in view of the scheduled Final Conference of the project that will be hosted by CANaH in Athens in

September 2011. At this conference leaflets in all languages will be made available to the participants. These leaflets have already been disseminated at various EU workshops and LLP project meetings where some of the project partners participated. These dissemination activities are presented in the Confidential Part of the Progress Report. The leaflets in every language are available for downloading in pdf format from the public section of the project website.

A poster in English language in A3 format has been designed and is available for any partner who will participate in any pertinent conference. The poster is also available for downloading in pdf format from the public section of the project website..

4. Partnerships

The Consortium is composed of seven organisations from four European countries (Greece, Italy, Turkey and Cyprus), all Mediterranean that face similar problems with water resources and distribution. Some of these countries have old and non-homogeneous networks that are subject to ageing, massive water losses, seismic activity and other natural hazards.

The Consortium includes universities and research institutions, an ICT organization, VET providers and urban utility networks, selected with a view to their knowledge and experience. Their knowledge and experience is complementary and essential to the project. The partners have also extensive experience in national and transnational cooperation and have participated in numerous European research projects and Lifelong Learning projects. The partners provide the scientific knowledge, validation, deployment and integration of the results of the project. The distribution of tasks to the various partners in the Consortium, with their diverse knowledge and expertise, provides a significant European added value to the project.

Additional European added value, which strengthens the quality of the Consortium, is the involvement of Contributing partners at an early stage of the project. These contributing partners have cooperated closely with the principal partners of the consortium during the implementation and dissemination phases of the project and also participated in the second meeting of the project in Aquila- Italy. The contributing partners include universities, VET providers, water utilities and SMEs involved in the water sector. They come from Italy, (ANCE ATO3 – Macerata, University of Ancona, University of Aquila, ATO Abruzzo, Gran Sasso Water spa, ANCE Abruzzo), from Finland (ECO-ONE and SYKLI) and the Netherlands (Vitens water utility and Innovation S.A.). Additionally, engineers from a number of water utilities in Greece (e.g. Athens Water Supply and Sewerage Company and the Municipal Water Utility of Patras) have taken an active interest in the progress and final products of the project. The number of contributing partners is expected to increase in the forthcoming months as a result of the dissemination activities that are being actively promoted by members of the consortium.

The roles of the partners (see acronyms in the Appendix) in brief are:

- Expertise in PM methodologies (thematic expertise): **CANaH, PAU**, ECO-ONE, INNOV, UNIVPM, ANCE Abruzzo, VITENS, ATO3, Università Politecnica delle Marche, Gran Sasso Acque spa.
- Expertise in training methodology principles (thematic aspects): **CANaH, PAU, TR2000**
- Courseware Content Providers: **CANaH, PAU, TR2000, DENIZ, WBL**
- e-learning platform developer: **RACTI, HSD**
- Simulator developer: **RACTI, HSD**
- Partners providing vocational training: **CANaH, PAU, TR2000**, ECO-ONE
- End-users water utilities partners: **DENIZ, WBL, ATO3**
- Evaluator: **TR2000**
- Dissemination: All (led by **CANaH**)
- Exploitation: All (led by **HSD**)

The partners identified in **bold** are the principal partners.

The synergy, interest and momentum that have been created among all the principal partners and especially of the contributing partners from the outset of the project, has been impressive. The European partnership, close cooperation and commitment of all the partners involved in the project to achieve optimum results have been key factors for the successful execution and dissemination of the project.

5. Plans for the Future

The project activities that remain to be performed until completion of the project in October 2011 are as follows:

- Completion of the MOODLE e-platform, further testing and translation into the remaining three languages from the English version.
- Completion of the course material in MOODLE , translation from English to Greek, Italian and Turkish languages, pilot testing
- Completion of the training simulator software, testing with actual data and pilot training by personnel of the participating water utilities in order to fine tune the system.
- Organizing of pilot training sessions by the end-users in two groups: (i) engineers and managers and (ii) maintenance personnel from the water utilities in the participating countries. The pilot training period has been extended in order to allow for increased interaction with the training system.
- Planning and organisation of the final project conference in Athens in September 2011 prior to the end of the project. This is a principal source of dissemination and diffusion through presentations and publications of the final results of the project.
- Continuation and intensification of the Dissemination activities by all partners at technical conferences, specialist meetings, other LLP project activities and meetings, symposia etc.
- Commitment to maintain and update the Project website and MOODLE platform for a minimum of five years after the end of the project or until there is sufficient interest.
- Exploitation of the end results of the project through extended educational activities to a wider global audience through the web.
- Publication of results and recommendations in technical journals and conferences proceedings and poster sessions.
- Negotiations with public bodies with respect to partly or fully adopting the outcomes of the project in their current policies and practices.
- Final evaluation of the project

The anticipated final results of the project will be:

- A multilingual web-based courseware for training programs for preventive maintenance of urban water utility networks. The courseware will be made available on the web and off-line in the form of CDs in 4 languages (English, Greek, Italian and Turkish).
- An accompanying training simulator that will also be available on a CD accompanied by a user manual. The simulator will offer the trainee a facility for rapidly estimating the reliability of the water utility network under different environmental conditions and suggest ways on how best to rehabilitate the network in order to increase its reliability.

6. Contribution to EU policies

In the proposal it was stated that the project is relevant to the Transversal Policy: *Exploiting ICT in Learning*. This means that extensive use is made of ICT for learning in the form of a web-based platform and courseware as well as advanced software tools (GIS, DBMS, simulation, risk analysis, decision-support) for VET. The training simulator has been based on an earlier FP5 research project named SEISLINES.

This project is also complementary to a previous Leonardo da Vinci project named PROWAT (Planning and Implementing a Non-Revenue Water Reduction Strategy Improves the Performance of Water Supply and Distribution Systems) described in detail at the project website <http://www.pro-wat.com>.

7. APPENDIX

Acronyms and websites of the principal and associated partners

Principal Partners

RACTI - Research Academic Computer Technology Institute, www.cti.gr

CANaH - Centre for the Assessment of Natural Hazards & Proactive Planning, naturalhazards.ntua.gr

PAU - Pamukkale University, www.pau.edu.tr

TR2000 - Training 2000, www.training2000.it

HSD - HS Data Ltd, www.hsdata.com

DENIZ - Denizli Municipality, www.denizli.bel.tr

WBL - Water Board of Lemesos, www.wbl.com.cy

Associated Partners

ATO3 - Water Authority, Marche region, www.ato3marche.it

ANCE- ANCE Abruzzo, www.ance.it

UNIVPM - Università Politecnica delle Marche - Department of Hydraulics, Roads, Environment and Chemistry, www.isac.univpm.it

INNOV- Van der Meer & van Tilburg innovation consultants, www.innovation.nl

VITENS - Vitens Water Supply Co., www.vitens.nl

ECO-ONE - ECO-ONE, www.kolumbus.fi/eco-one

SYKLI - SYKLI Environmental School of Finland, www.sykli.fi