

**CASE STUDY** : Digital diagnostics system for sewer pipes

**SECTOR:** Water/Sewerage  
**COUNTRY:** Finland

**BACKGROUND**

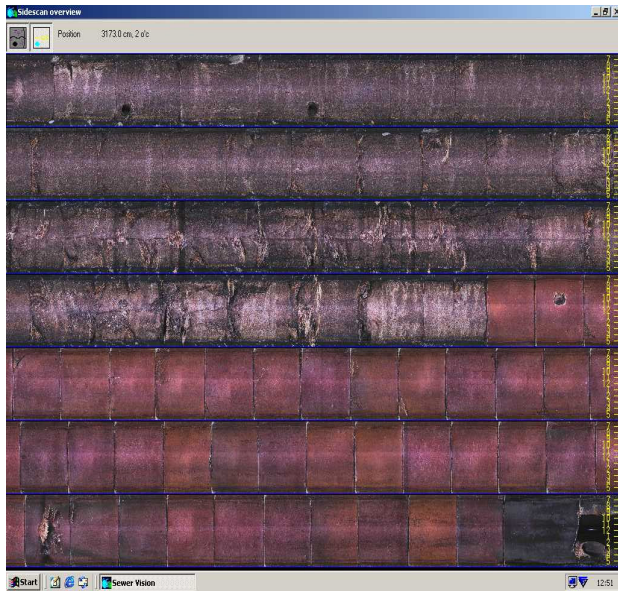
The background of the project is the experience gained from the USA and Japan concerning the Sewer Scanner Diagnostics. During 1998 – 2000 VTT Building and Transport made research on Sewer Scanner Data collected from a test pipeline in Helsinki. The research was part of the international COST Action C3 “ Diagnosis and Maintenance of Urban Infrastructure”[1]. The work continued in 2001 as a feasibility study for “ Smart Digital Diagnostics System for Sewer Pipes” in a national technology programme called “ Water Services 2001”[8]. After a successful feasibility study, work continues at the moment with a goal to develop a new diagnostics system which is able to interpret very accurate digital image data according future CEN standard (Visual Inspection Coding System)[9]. The project is part of the national “ Infra Technology Programme “ and it is executed in co-operation with firms from Finland, USA and Japan. The system will measure and analyse the condition of the sewer pipe. The system is meant to support network wide regular condition monitoring and proactive maintenance [5]. When the service level and the investments for that are optimised according the predicted life span of the network this type of measurement systems is needed. The core of the system consists of VTT’s diagnostics software and a Japanese Sewer Scanner. A lot of new type of data is produced challenging the GIS systems used in Water Utilities today. Helsinki Water has started to collect this new data last year as a first water utility in Europe. When the system was demonstrated in the International NoDig 2002 Conference in Copenhagen in June over 6km of data was collected from Helsinki [7].



Besides in Finland the SSET field demonstrations and data collections are made in Germany (Hamburg), Denmark (Copenhagen), Sweden (Malmö, Stockholm, Gothenburg), Norway (Oslo), Russia (St. Petersburg), in Latvia (Riga) and Estonia (Tartu) [3].



First tests in Finland were made in summer 1998 in Helsinki. The probe was a second-generation prototype, which had built according the feedback from the US field tests [2]. It included a fisheye scanner with mechanical gyroscope. The data produced was clearly good enough to build an automatic interpretation system on top of it. At the same time the CEN standard covering the coding of defects in sewer pipes was developing rapidly providing for the first time an all-European market for sewer inspection. VTT started preliminary planning of new diagnostics software [10].



SSET technology differs from CCTV in that it produces very accurate digital side scans of the pipe wall instead of producing only forward looking continuous video film of the pipe. It also produces very accurate online location data with help of two different measurement systems. The key word is accuracy. It allows measurements beyond dispute compared to individual interpretation of CCTV data.

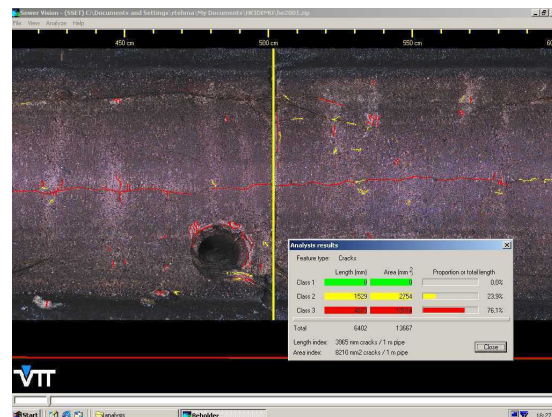
The digital condition measurement system for sewer pipes scans the pipe wall with 1-mm accuracy. Millimetre after millimetre it makes one ring scan. It produces open folded side scan of the pipe. The image is continuous. Besides the side scanning the probe captures front view image every 10-cm. The distance is possible to adjust.

The inclinometer will register vertical movement and the gyroscope will register horizontal movement. The distance from the starting point is measured from the power cable. If the x, y, and z co-ordinates of the starting point and the ending point are given, the system can count the co-ordinates of the centreline of the pipeline.

This type of accurate data allows itself for time series analyses. The test pipeline in Helsinki was measured in

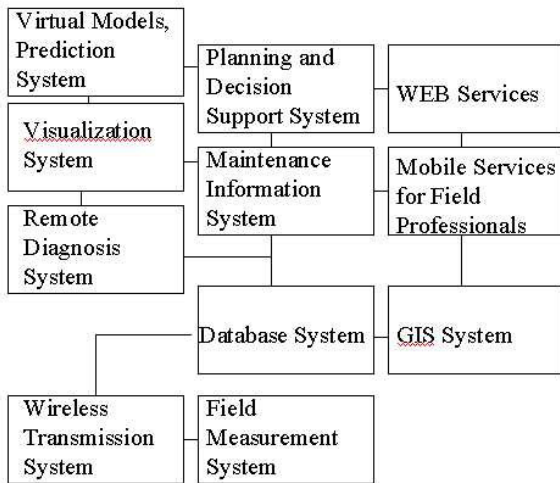
1998, in 2000 and in 2001. The sewer line is in very bad shape and it had to be renovated in 1998, but Helsinki Water has promised to keep it as it is as long as possible for scientific research purposes. With this new measurement system it is possible to compare the changes which have happened inside the pipeline [11].

It is possible to monitor how the defects will develop and to measure changes, which will happen. In the same way, it is possible to monitor pipeline movements (usually sinking) both vertically and horizontally. This is important because the life cycle of pipeline segment may be 100 years before it will be rehabilitated. The regular monitoring cycle of network in those agencies, which have taken in use optimised maintenance strategy, is usually 10 years. Without this type of measurement systems it is very hard to make any comparisons what has happened during 10 years and to predict the serviceable lifetime of the pipeline segment.



At the moment the focus of the research and development is on the direct defect analysis. When the software is completed all the measurements and analysing work is made immediately on site after the data is collected. Those results, which are alarming or otherwise need taking care, are transferred wirelessly to predefined persons or to information systems direct from the field. The project will end in March 2003.

**Management System  
for Sewer Network Maintenance  
System Concept**



In the future the shape measurement capabilities are developed. Then it is possible to make shape analysis, which is important for plastic pipes. It is also possible to develop an optical distance measurement system, which makes distance measurements even more accurate than today [12].

The measurement system VTT is developing makes it possible to monitor and measure what happens in underground sewer pipes. It also makes it possible to improve our understanding of how the changes will happen. The measurement system is developed so that it is easy to connect to GIS systems and other information systems where it is needed [5]. The information is in connected with prediction and decision making and how the future of the network is defined.

In summer 2001 VTT benchmarked [4] eight USA water utilities to better understand the similarities and differences between Europe and USA. The visions US Utility managers presented confirmed those opinions their European colleagues had already presented in connection of the COST C3: The management of the utility must built on data you can trust. In the future it

must be digital data and it must cover all vital assets and activities of the utility.

The new system is coming to the European market in 2003.

**IMPACT ON SUSTAINABILITY AREAS**

Ecology		Economy		Social aspects	
Are emissions to air, water and soil within the restrictions set locally and internationally? Are the emissions decreasing?	soil 	Is the cost/effectiveness and/or cost/benefits of the system reasonable compared to other systems? Compared to other needs in the city and to political goals?		Has the planning and decision-making for the infrasystem been done in a democratic and participative way?	
Is the use of natural resources reasonable compared to other comparable systems? Is the use decreasing? (e.g. fossil fuels, water, phosphorus potassium)	Ground water 	Are the citizens willing to pay for the services offered? Are the services affordable to all citizens?	predicted 	Are the function and the consequences of the system transparent to and accepted by the citizens? Is the system promoting a responsible behaviour by the Citizens?	
Is the system allowing a reasonable biodiversity with regard to the kind of area studied? Is the biodiversity increasing?		Is the organisation(s) that finance, maintain and operates the system effective?		Is the system safe to use for the citizens? (hazards, health, well-being)	
Is the system more or less sustainable than a conventional system regarding ecology?		Is the system more or less sustainable than a conventional system regarding economy?		Is the system more or less sustainable than a conventional system regarding social aspects?	

Environmental :High    Economical: High  
Institutional: Medium    Social: High

**PROJECT CONTACT**

Project manager:

Senior Research Scientist Hannu Maula,  
VTT Building and Transport  
Hannu.Maula@vtt.fi

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