ASSET CONDITION SURVEYS (ACS) FOR SEWERS AND AUTOMATION TOOLS

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Abstract

NWW are responsible for the provision of sewerage services to seven million people. This sewerage infrastructure has developed over the last 130 years to a point where there are upwards of 37,000km of sewers, 1,000,000 manholes and many thousands of ancillaries. A number of these sewers and ancillaries have now reached the end of their operating life. Bechtel Water Technology has employed the use of Information Technology tools to allow their Client to assess the information and carry out risk management analysis of his asset stock so he can efficiently target assets for survey and future capital investment.

Use of this technology has improved the efficiency of undertaking this type of work and has provided the Client with a tool that can be fully audited.

This paper describes the processes used on the Asset Condition Surveys (ACS) - Sewers project, highlighting the issues involved and the methodologies that were applied to deliver the final outputs.

Introduction

In 1996, as part of the North West Water (NWW) / Bechtel Water Technology (BeWT) Partnership, NWW requested BeWT to commence a programme of asset condition and serviceability projects covering all its Wastewater Assets. This comprised 600+ wastewater treatment works, 37,000km sewers, 1500+ sewerage pumping stations, 2500 combined sewer overflows and 400 detention tanks. The key objective of these projects was to improve NWWs knowledge of the asset stock, its condition, and serviceability. This information, in turn, was to be used for the Asset Management Plan (AMP) reporting, which all water companies are currently undertaking, and to identify capital investment by targeting assets at risk of failure or dereliction.

Background

Over the last 10 to 15 years, all water companies have been gathering a significant amount of data on their assets, their performance and condition. Unfortunately the technology to interrogate and assess this data has not kept up with the ability to collect it. Historically this problem was resolved by labour intensive manual assessment and analysis of the data which was done to varying standards, expensive to refine or change and therefore often proved to be difficult to audit.

BeWT recommended that the best way to deliver the outputs on the ACS-Sewers project was to fully utilise the cutting edge IT tools which are readily available in the market place. Large datasets were to be evaluated and the use of automated systems compared to manual processes was essential to the success of the project.

Failure mechanisms

As the use of information technology can only take place if the data is available, BeWT drew on the expertise within the company to identify the key factors that affect the condition and failure processes of a sewer.

It was recognised that the list of factors was theoretical and would be subject to the availability of the relevant information. The list of factors was matched to the digital data which was either currently available to the Client or could be made available via other routes. After a difficult investigation process, the sources of data covering the major factors were made available to the project. They included: road layouts for traffic loading, ground conditions, water mains and their likely condition and most importantly, sewers, their attribute information and importance to the Client.

In addition to the factors affecting failure, it was noted that historical information recording the performance and failure of sewers would be vital in locating sewers that were reaching the end of their life. This data is held by NWW on its sewer incident recording system (SIRS). This system has been in place for the last seven years and is used by NWW to track and report on its sewerage agent's performance in dealing with complaints from the customer.

The method of categorising failures has been long established and is standardised through the UK using the Sewerage Rehabilitation Manual. This grades sewers from 1 to 5 (1 being in perfect condition and 5 being in a state of collapse).

Data Assessment and cleaning

Once the data was obtained it was clear that the quality of the information varied and the form of the data was not suitable for geospatial assessment.

A typical example of the problems encountered was the method of recording the location of an incident within NWW`s SIRS database. This database has been in place for seven years. Over this period the agents have recorded in excess of 350,000 incidents. The method of recording the location of each incident was based on postal address. Unfortunately this level of information was not suitable for linking to the sewer records and other factor information. The data required to link the SIRS database to other data sets was a grid reference. The method employed by the sewerage agents was to insert the address of the complainant and or the address of the incident. The recording of this address data was done to different standards depending on which agent carried out the work. The problems encountered included spelling mistakes, incorrect house numbers and abbreviations.

To resolve this problem a semi automatic post code/address system was utilised. This had the ability to convert house numbers into numerical figures, abbreviations into the full words, and would make a best guess at the word if miss spelt, it would also flag it up as a best guess. This refined data was then processed though a postal address matching software package, which had the ability to provide a grid reference, based on the level of information given. This final data was then graded to provide a confidence limit to indicate whether the grid reference was based on the full address or a part. This work was completed for 1/10 of the cost of doing it manually with a system that, if required, could be fully audited.

This type of problem was one of many encountered on the project, others included the matching of sewer records to the CCTV condition information (PRISM) and matching sewer records to the various asset registers. All of these problems have been resolved using automated processes.

IT Review

At any early stage of the project it was noted that most, if not all, of the data which had been identified as being useful to the project contained some form of spatial information. To allow the full use of this data, a set of key criteria was produced which the proposed software needed to meet:

- Ability to display spatial data
- Ability to accept the forms of data obtained from the Client's databases
- Able to run on BeWT network via PCs
- Easy to use, as the design team were Civil Engineers not software Engineers
- Adaptable to the needs of the project as and when they were identified
- Able to manipulate and display large data sets
- Available immediately off the shelf to meet the tight time table of AMP reporting
- Acceptable cost of software compared to pay back.

After a brief review of the available software packages it was confirmed that the MapInfo software product achieved all the above. In addition to the base software package, further 'bolt on' modules were purchased to assess and display the data. It was recognised that the main advantages of this software were the interface with the Microsoft packages being used on the project and that it was user-friendly.

IT Application

It was recognised that the development of the methodology to identify structurally derelict sewers, and sewers which would impact on the business if failure occurred, would be progressed through a series of iterative stages as follows:

Stage 1 A process of building up base layers of raw data was carried out, starting with the ordnance survey maps of the region. This was followed by the sewer and water main records, which in turn were overlaid by ground condition information and the location of sewer collapses recorded on the SIRS data.

Stage 2 The historical information on collapses (SIRS) was analysed and displayed using a specific module of the MapInfo software. This converted a measle map data set (i.e. points on a map) into a location profile map. This information was then further enhanced and presented in the form of a contour map based on the number and average distance of incidents relative to a pre defined grid. This stage then produced a hot spot map of recorded failures.

Stage 3 To identify sewers which may be at risk of failure and where the consequence of failure would be significant, a process was developed to flag sewers which were at risk of failure due to their location to external influences.

Stage 4 The information derived during stage 2 was then combined with the information produced during stage 3. This was then used to produce a definitive list of sewers that if surveyed, would have a high probability of being condition grade 4 and 5. Using the same software package, the sewers selected for survey were ranked in terms of the scoring system that reflected the probability of the sewer being in poor condition.

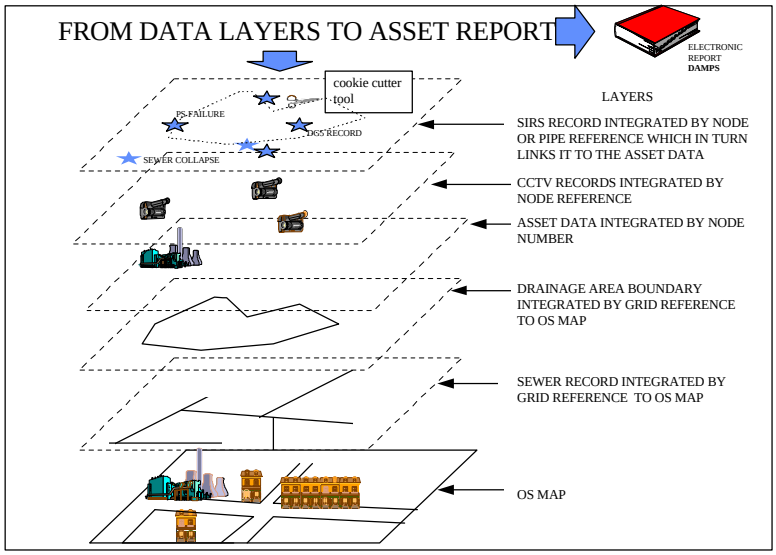
Stage5 Using the interface between MapInfo and a Microsoft database, all sewers selected were assigned a predicted survey cost. In addition, schedules of sewers for survey and plans indicating the survey locations were produced.

Results

To date the team has screened and assessed all NWWs recorded sewers and has produced a schedule of sewers for survey covering 48 sewerage agents. Approximately 75% of the sewers selected have been visited on site with the resultant surveys showing a significant return in terms of sewers surveyed compared to the number identified as being condition grade 4 or 5. The remaining 25% of sewers selected are with the CCTV contractors awaiting survey.

Conclusions and the future uses of the technology

NWW now have a tool and the expertise to manipulate and assess many forms of spatial data which has generated several ‘spin off’ projects. The knowledge gained during the ACS - Sewers project has been used on other projects covering the statistical assessment of combined sewer overflows, the production of drainage area studies and the production of paperless reporting systems. To this end, the following shows the layering of data currently being developed by the Study Group to produce the paperless reporting of assets:



It is clear that the use of Information Technology when assessing the condition and performance of assets is the correct way to proceed. It provides the user with a tool that can assess spatially, analyse and report on vast amounts of data, with

improved efficiencies over previous methods. It allows the user to carry out functions which until recently were thought to be impossible, and it allows the user to do the same operation again and again in a fully auditable way.

DISCUSSION

Question **Jeremy Lumbers** **Tynemarch**
In your prediction of rules for failure did you only use collapse rules?

Answer
For the project we just looked at collapse.

Question **John Blanksby** **Sheffield Hallam University**
You had a hit rate of 45% for 3 ,4 and 5 , were the sewers not matched to the sewer records?

Answer
No they were not surveyed sewers.

Question **Steve Roberts** **WS Atkins**
What proportion were critical sewers

Answer
I will find that information out later.

Question **Bridget Turner** **Binnie Black and Veatch**
Anecdotal evidence from operators is very useful, do you have a field for this? Do you use them?

Answer
Yes we have used it. Yes we did a full review with the District Councils , we went through everything with them.