NUMERICANAL

Report on the delivery of UK Pilot Action for the Numericanal project

Roundberry Projects

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1. Introduction

The Canal & River Trust (CRT) was the Lead Partner in the European Commission INTERREG IVB programme funded Numericanal project which ran from 2011 until October 2015. Other partners in the project were waterways management, safety and technical organisations from France, the Netherlands and Belgium.

Transnational working to pilot technological advances on smaller waterways in North West Europe (NWE) was at the heart of Numericanal. As part of this the CRT received funding for establishing a Control Centre for waterway management. The purpose of this report is take stock of the delivery of this pilot action and to support the development and roll out of control centres in other EU member states. As such it delivers Output 4.2.1 of the Numericanal project in Work Package 4 Action 11.

This report is based on telephone interviews and email questionnaire responses from CRT staff in three fields: programming and technical, scheduling, maintenance operations. It is reinforced by interviews, observations and information collected during completion of the Holistic Numericanal Evaluation including attendance at the demonstration event in Hatton in October 2015.

2. Objectives for the pilot

At the outset the CRT vision[1] was to:

- Establish a functioning control centre for waterway management including tools, systems and interfaces;
- Demonstrate ICT as a means for resource efficiency by enabling, through remote control and monitoring, effective deployment of manpower skills;
- Provide a catalyst for uptake of this approach in other NW Europe cities, regions and countries. Partners will use these strategically significant facilities to communicate opportunities and potential benefits to a wide and varied audience including organisations from the waterway, ICT and policy sectors;
- Help increase awareness and appreciation of the waterways as a resource and, by advancing management practices, secure resource availability and engage stakeholders for longer-term sustainability;
- Deliver a report on the pilot action, which will be used to support the development of a roll-out strategy for Eijsden-Margraten and the wider dissemination of results.

3. Rationale for developing a control centre

Along with other partners in the Numericanal project, the CRT had identified that “control centres” taking advantage of developments in ICT could provide centralised contact and delivery points for managing inland waterways more effectively and efficiently. A number of issues had to be explored and considered including technical and regulatory

[1] As in the project documentation relating to Work Package 4 Action 11

requirements, connectivity, security, data protection user restrictions and the supporting software.

Numericanal partners realised that their individual circumstances meant that it was not possible to establish a single common control centre model for North West Europe, however there are a number of common factors relating to functionality as set out in Figure 1 below. A comprehensive report of these has been completed on behalf of the partners by Hyder Consulting[2] and should be found on the Numericanal website (Numericanal.eu).

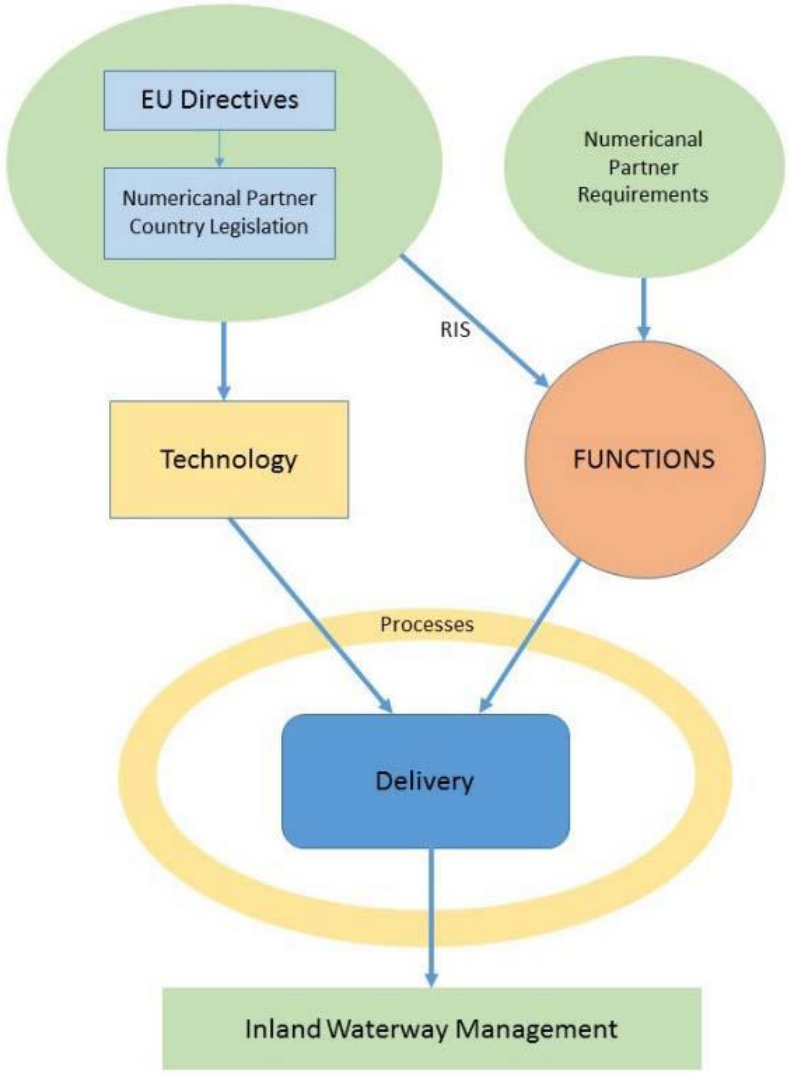

Figure 1: Purpose & Functions of a Control Centre, Source: Hyder Report

Specifically for the CRT the key driver for the control centre identified in 2010 was operational efficiency relating to three aspects: resilience, mobile working and automation of structures.

[2] Control Centre – European Common Model, Hyder Consulting (UK) Ltd.

3.1 Mobile working

As the organisation responsible for managing 8500 structures and 2000 miles of canals and rivers in England and Wales much of which is over 200 years old, the CRT needs a large operations maintenance team. A significant effort is put into programming maintenance and major engineering.

The maintenance and engineering teams had been reliant on paper-based systems. This lead to long delays in data being fed back to those programming the work. Before this pilot scheme it could take 3 months for data on 1 week's work to be fed back. The data from timesheets would show which tasks had been completed and how long these tasks took. This information was also used for financial planning.

The CRT was very keen to harness the opportunities provided by mobile devices that could be supplied to all bankside staff to speed up and improve communication.

3.2 Resilience

A "Duty Supervisor" system is in place to respond to alarms and emergency calls relating to the waterways. The current system has teams of staff being on a duty rota where for 1 week in 6 they are on call 24 hours a day for 7 days.

This raises two weaknesses. Firstly, the call system relies on the mobile phone network. The alarm/emergency calls are not always received by the team or time is lost in trying to reach the appropriate person.

Secondly, the fact that staff are on call 24/7 increases the incidence of human error. Staff are woken during the night and may not be able to make the best decision in this situation. Staff may not have all the relevant information available at that point to make the best decision. Then, having been woken up, possibly several times, in the night staff may not function so well during the day.

In one example given, a decision taken in 2015 in these circumstances led to costs of £200,000 being incurred by the CRT as the team member involved did not fully understand the situation and the implications.

Moving to a control centre staffed 24/7 is therefore considered an improvement to the organisation's operational resilience. Staff will be immediately contactable, more alert at night, and able to deal directly with these situations by having full access to necessary data.

3.3 Automation of structures

Waterways in other parts of North West Europe, partly due to being more commercial in nature, have developed automated structures (bridges, locks). Some of these can also be operated remotely i.e. by the skipper of a vessel or from an off-site control centre.

The CRT was keen to look at the possibility of introducing these technologies in the UK. It was decided to focus the pilot on the Gloucester & Sharpness Canal which has 14 bridges. On some waterways road swing bridges need to be operated by an on the spot staff member (bridge-keeper). Operational costs mean that the canal may be closed overnight or on certain days when it is not considered cost effective to man the bridge to open it for boaters.

Introducing this technology which could be managed through the control centre would bring benefits to boaters as well as potential cost savings.

4. Factors encountered during set up

The programming and technical staff involved in establishing the control centre at Hatton believe set-up was relatively straight forward with no problems encountered that were outside the scope of those expected in any such development. Problems encountered appear to relate to the remote locations of waterways, for instance in there being insufficient mobile phone network coverage and the ability to relay CCTV images from the site of a structure to be remotely operated to the control centre.

Within the organisation there were some delays in developing the pilot actions because of the internal procedures required in delivering a development on this scale.

Specifically on the introduction of the pilot remote bridge operation at Sandfield in Gloucestershire, there was some delay due to concerns from local residents. The CRT team has drawn on technical knowledge gained from visits and exchanges with colleagues at Eindhoven and Eijsden-Margraten in the Netherlands and the Voies Navigables de France. At Sandfield residents were concerned about safety, emergency road access as well as job security for the bridge-keepers. An information and consultation process with residents and local authorities was established to enable the pilot action to be implemented. More information can be found on the CRT website[3].

5. Current Control Centre Operation

The control centre itself became operational in April 2015 and was located at Hatton, in Warwickshire in the centre of England. This is an established CRT regional site. A team of three people (Schedulers) was recruited and undertook training which now enables them to schedule the CRT's whole maintenance and engineering operation. The CRT has chosen to introduce the new functions at a managed pace to enable the changes to bed-in properly. There was a concern that a big bang approach could be painful in terms of staff not being able to deal with a large volume of queries adequately.

[3] https://canalrivertrust.org.uk/about-us/our-regions/south-wales-and-severn-waterways/gloucester-and-sharpness-canal-bridges

5.1 Scheduling and mobile working

The Schedulers look at the tasks which need to be carried out in the short term, working approximately 2 weeks in advance. They assign and schedule team members to undertake tasks which have been programmed. Programmers create and maintain the long term programme of tasks, programming the entire year's worth of tasks. Schedulers rely heavily on the programme being correct for the upcoming two weeks, allowing tasks to be accurately assigned. Any task that falls outside the two week period is referred back to the Programmers as it may have longer term implications. A detailed explanation of the scheduling process is in the Appendix of this report.

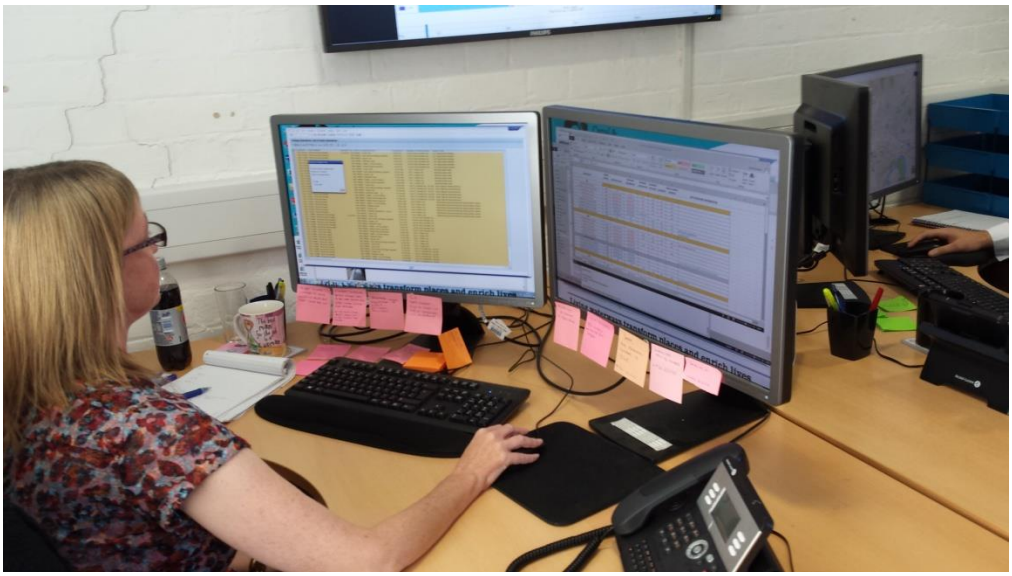

Figure 2: Scheduling at Hatton Control Centre

Scheduling has been enabled through the introduction of mobile working technology. 764 handheld devices were configured and given to the maintenance and operations teams, generally known as "bankside" staff. These tablet devices give the bankside staff access to far more information than before – they can now access all the same information as office staff, for instance HR and internal news related emails as well as technical information. The latter can help in diagnosing or pre-empting problems such as flooding.

Bankside staff receive details of the tasks to be carried out through the mobile devices and can either update the device immediately or later to confirm that a task has been carried out and how long it took. This information is uploaded back to the Programming team once a week (on a Monday morning) so the feedback to Programmers is now very quick. This used to take up to 3 months previously as the paper-based system had to be passed through supervisors either weekly or monthly and then passed monthly to a central point for scanning in before being made available to Programmers. The mobile devices use Prometheus software which was configured by MX Data for roll out to and use as an App by staff. The in house team worked with suppliers to deal with tweaks that have been necessary during system implementation. The mobile devices have also widened the use of the pre-existing SAP software for scheduling amongst bankside staff.

Much effort has been put into training the Schedulers with the SAP software system and looking at how the mobile devices can bolt into existing systems. For the first 3 months

Schedulers concentrated on familiarisation with the work regions and teams. They worked with one bankside team to ensure that robust procedures could be established and any bugs in the software ironed out before rolling out more widely.

5.1.1 Feedback

Feedback from the bankside staff has been generally favourable. They can see that it saves them time in being able to access CRT systems and documents from remote locations and without having to go via a number of people. Initially there was some resistance as teams could previously decide when they did certain tasks, but once the new processes had been explained this seem to have been allayed. These teams are now coming back to the Schedulers when they see problems that have occurred and asking for useful changes to be made. There are some issues which appear to be solvable and perhaps could be seen as teething problems regarding:

- Duplication of work (having to input information and not being sure that the device has actually sent the information through as it seems to be requested again)
- Some attachments will not open on the devices
- Not being sure that the Hatton staff understand the logistics of some aspects of bankside work
- The system updates every few hours, not instantly.

5.1.2 Benefits

There is now a much better understanding of how long tasks take and which resources are required to carry them out. The speed with which information is passed back means that programmes and schedules of work are more effective. Mobile working devices have also enabled useful new information to be collected on “near misses” with regard to health and safety issues as well as “handling hours” where staff need to use water craft for which they need boat licences. There is a cost to the CRT in paying for boat licences so they aim to make efficient use of craft and licences.

5.1.3 Skills

In establishing this new way of working it has become clear that there is a difference in the skill set needed between Schedulers and Programmers. Schedulers concentrate on particular tasks and allocating that to the correct team. It was felt that this was a skill set that couldn’t necessarily be bolted on to existing jobs. The Schedulers believe that consistency in the processes implemented is essential.

There has also been recognition that effective Scheduling relies on accurate and timely information being supplied by Programmers otherwise the wrong information is given to bankside teams. Training has been given to Programmers on the requirements of working within the new system.

It has been very important to develop the relationships between the Schedulers and the staff receiving the task information.

5.2 Automation of Structures

The remote operation of Sandfield bridge continues to be trialled as a significant amount of development has been necessary.

Figure 3: Sandfield Bridge, Gloucester & Sharpness Canal

A Wi-Fi hotspot has been created around the bridge; boaters wishing to open the bridge will need to have downloaded an App to their Smartphone or mobile device and the use of Wi-Fi makes the system reliable where mobile phone signals are not reliable. Only boaters who hold a boat licence can download the App.

A pre-set sequence for bridge opening has been established. For safety and security reasons this cannot be over-ridden by a boater. Emergency (road) vehicles needing to lock the bridge can send a signal to the control centre which needs to be manually inputted. Lasers have been installed on and around the bridge along with lights and barriers to check that the bridge deck and the water either side is clear. Additionally CCTV cameras have been installed for off-site monitoring at a control centre. Bankside communication equipment has been installed so that boaters or passersby can contact the control centre if necessary. Other protocols have been set up, for instance creating a limit to the number of times that the bridge can open at rush hour and other times of the day.

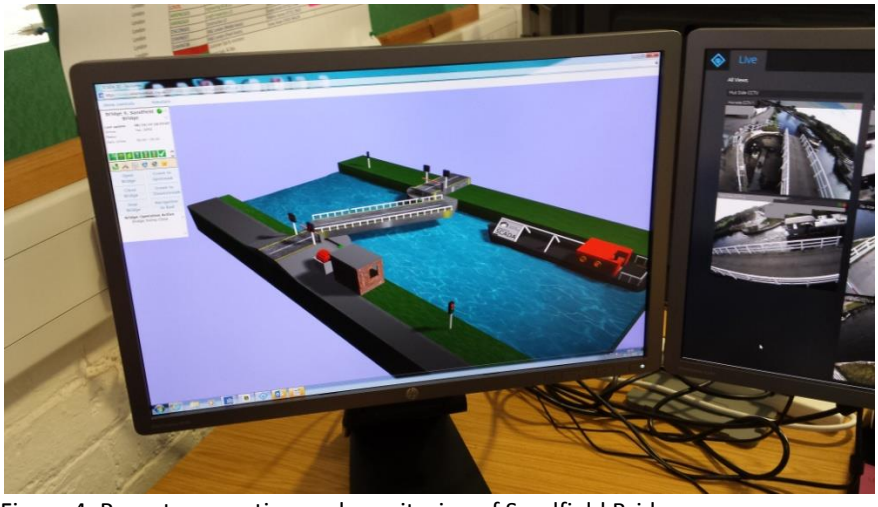

Figure 4: Remote operation and monitoring of Sandfield Bridge

The biggest problem in developing and implementing the technology has been in the ability to relay CCTV images and data to the control centre. Bridges are in remote locations without fibre optic cables or 3G coverage. The solution so far has been to link the Sandfield bridge to the nearest CRT centre at Gloucester by a slower connection and to slow down the CCTV image refresh to accommodate this connection. All the CRT's offices are connected by fibre optic cable and so data/images can be quickly transferred between them. Therefore the images can be viewed at the Hatton control centre as well as at the Gloucester offices. The internet infrastructure in the Sandfield area is due to be upgraded in 2016 and this should solve the problem. The software used in remotely operating the bridges is seen as being straight forward "off the shelf" and reliable.

Initially the bridge remote operation will be monitored by bridge-keepers.

5.2.1 Feedback

As the trial has still to be fully rolled out to boaters feedback is so far limited. However initially the UK Barge Association is positive about the development because it will mean the canal is open for longer periods.
There have been concerns from bridge-keeping staff about their positions.
The largest section of feedback has been from the community around Sandfield bridge for whom the bridge is a key access point. They have been very concerned about the ability of emergency vehicles to gain access as well as potential congestion and road travel delays. The CRT has undertaken a major consultation and stakeholder process to address these concerns.

5.2.2 Benefits

Automation of the 14 bridges on the Gloucester & Sharpness canal will cost £4.5m, however much of this cost is related to improving the bridge itself and would have been incurred as part of the CRT's maintenance programme. It is estimated that the cost of the technology specifically for remote operation (lasers, CCTV etc) is around £70-80,000 per bridge. The CRT believes that remote operation of these bridges will bring about a 10-11% efficiency saving, around £500,000 per annum.

5.2.3 Skills

It is currently believed that monitoring of the remote operation needs to be done by those with specific bridge keeping experience. During the trial period this will be at a bridge control room on the Gloucester & Sharpness canal.

6. Future developments

6.1 Scheduling and Mobile working through the Hatton Control Centre

In February 2016 the Scheduling team will take on responsibility for assigning CRT's hire fleet (work boats). Fleet monitoring (vehicles) will start in April 2016 with a view to both of these being fully operational within 12 months.

Looking to the future, bankside staff have asked whether it would be possible to be all working on one system e.g. Apple, Android, and Microsoft. The Scheduling team report that they feel they can shape the service and suggest changes to processes that may become apparent as the control centre embeds.

6.2 Automation of Structures

The trial on the Gloucester & Sharpness canal will be extended in 2016. As the trial operation is assessed the team will look at whether these structures will be monitored from the Hatton control centre or elsewhere. If this is to be from Hatton there is a view that this would need to be by additional staff to the Schedulers, perhaps with a different skill set.

6.3 Emergency response

Extending the Hatton control centre to encompass an emergency/immediate response function was widely anticipated by those interviewed.

At the moment the CRT operates a bespoke Supervisory Control and Data Acquisition (SCADA) system which monitors the waterways and triggers alarms, for example if there is a flood or system breakdown. These are responded to by the "Duty Supervisor" process. There appears to be agreement that this process is due for an update and that having it operated through a control centre manned 24 hours a day could bring benefits. There would however be additional staff costs associated with 24 hour manning. It was thought these could be outweighed by saving on costs incurred where the current system fails.

7. Conclusions and recommendations

The CRT has succeeded in establishing a functioning control centre at Hatton for waterway management which currently enables efficient and effective maintenance of the waterway. Staff feel that Numericanal has brought about a huge step change in the way they work. These developments have been very much part of working smarter and delivering efficiencies. They should also lead to increased resilience and stronger risk management.

The mobile working devices and software in this pilot action have demonstrably improved the deployment of manpower relating to bankside operations. Programmers now have more accurate information provided much more quickly. Bankside staff have access to more information to enable them to work more effectively.

Although still at a relatively early stage, the remote control and monitoring of structures should also bring about more efficient use of the CRT's resources as well as bringing benefits to waterways users through increased opening hours of the canal.

Due to delays in delivering the Numericanal project it is too early to confirm that this pilot action has provided a catalyst for uptake of this approach in other NW Europe cities, regions and countries. However there is already strong evidence that all the Numericanal partners have benefitted from this trial – the exchanges of technical knowledge and expertise have been useful to the CRT in developing these capabilities. The French and Dutch partners have stated their intention to remain in close contact to watch, advise and learn from the trial.

There is still work to be done in communicating these developments more widely; the Numericanal website is one avenue for this but plans expressed as part of the overall Numericanal project to work with NIWE and to exhibit at the World Canals Conference should be carried out. A communications programme for both boaters and separately for policy makers and similar stakeholders should also be put in place.

Overall there seems little doubt that by making CRT more efficient and resilient this trial will contribute to providing a better waterway to boaters and others who benefit from well managed canals and rivers such as walkers, neighbouring landowners and the environment.

Appendices

Consultees

The following CRT staff were invited to take part in this review by telephone and email. Overall, responses were received from 6 members of staff (40%), the number of those approached is in brackets.
Programming/ technical engineering team (4)
Control centre staff (3)
"Bankside"/Operations staff (8)

The Scheduling Process Enabled by the Hatton Control Centre

Adapted from a presentation by Jemima Bruntlett, Works Scheduler Team Leader

What does our process look like?

This is an example of just two internal delivery areas, Construction & Mechanical & Electrical.

- Emails are sent daily and weekly to the supervisors requesting for them to put their team member's names to the upcoming tasks.

- We always work 2 weeks in advance.
- The same supervisors and waterway areas are emailed on the same day of the week, every week.
- A 2 day deadline is always given for a response back.
- A reminder email is sent if no email has been received.
- Once the spread sheet is returned, we are able to assign the team members onto the tasks. Ensuring they are scheduled to individuals handheld devices in advance of the task starting.
- This allows us to work consistently.

Our main tools for Assignment and Scheduling
After running the report through SAP we can take the orders through into GWOS – this will allow us to drag and drop the team members names onto the tasks.

Scheduling
Once all team members are fully assigned to tasks, we use the mass change function to set all tasks to the Scheduled status. This is the final stage and allows the team members to see their tasks on their hand held devices.