



SBRI End of Phase Report Form

This report is the company's opportunity to describe the work undertaken during the contract. Describe what work was completed during the project and why this was important. If the work was part of a two phased programme this report will form part of the assessment for Phase 2, it is therefore important that applicants complete the form as completely as possible.

This report must be submitted within 14 days of the completion, or termination, date. The successful contractor should be well motivated to complete this report as completion of this report forms part of the contract.

The report should be submitted to Defra's Climate Ready team at Nobel House, 17 Smith Square, Westminster, SW1P 3JR.

The objectives of reporting:

- to report on the work undertaken, its success in meeting the project's agreed objectives and to provide information on the work so that this can be used in the assessment of further applications (if required and appropriate);
- to explain and prove expenditure; and,
- also provides the company with a comprehensive report to share with stakeholders and those that may help further commercialisation.

The report should be completed by the lead contractor, with input from any sub-contractors or project partners as appropriate. Please answer, wherever possible, on behalf of the business units, divisions, or companies which were involved in the work. If this is not possible (as a result of merger or acquisition, for example), please specify the organisation to which your answers refer.

Please answer the questions in the spaces provided. Try to answer fully, but keep your answers succinct and no longer than necessary to clearly explain them. When describing technical solutions, please regard your audience as being someone familiar with the technology, but not an expert. The report may be done in narrative alone, however diagrams or pictures may be added where these aid clarity within the restriction on the page limit of a total of eight sides of A4.

Because the true impact of an R&D project often takes several years to emerge, Defra or the Technology Strategy Board may approach you for up to six years after project completion to follow up on the questions in this report. Your co-operation with any such follow up work is greatly valued.

1. Details

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Project Reference: SBRI project on Infrastructure/ built environment climate resilient sector designs; InTouch Smarter Cleaning of Gullies - Tender Reference: CA0517_1

Report Type: Final Report

Total Contract Cost: £83,333 + VAT

Start Date: 2nd December 2013

End Date: 31st March 2014

2. At the outset of this piece of work what were your aims and objectives?

The Smart Gully Project at the outset aimed to facilitate the smarter cleaning of gullies in order to predict and therefore aim to prevent flooding incidents, by highlighting risks to UK Highways Maintenance Operators based on a combination of live gully sensor feeds, live and forecasted weather data, as well as gully and flooding history. This supports climate resilience by providing intelligent information to the operators, to inform and initiate flood mitigating activities.

The new and existing data has been analysed within the InTouch Gully Management System (with the build of new software functionality), and the sensors and systems have been trialed within the Redcar and Cleveland area. This enhanced system enabled confirmation of optimal locations and configurations for installing the wireless sensors, and determined key 'hot spots' and problematic 'clusters'. This provided insight into the practical application of installing 'few sensors' to represent a large area. Installation of sensors measured a range of data directly from within the gully pots, which when combined with live and predictive weather forecast data, provides a capability of flood prediction and therefore potential prevention via revised maintenance activities. This is visualised with the addition of an 'alert severity' warning, bringing any risk directly to the attention of the system user via a dashboard type application. Upon receiving an alert, the Highways Maintenance operatives consider immediate action to clear the gullies in the area, and in doing so aid the prevention of flooding incidents and their impact on the highways.

3. Please provide a summary of the outputs of this project and relate these to the original objectives. How do the outputs address the requirements of this competition?

General Update by Work Package:

- **WP1 - Hardware** – The network of gully sensors, measuring silt, water and salt levels has been delivered and installed into key hotspot locations within the Redcar and Cleveland area. A series of rain gauges have also been installed within the same areas in order to obtain localised weather events and actual rainfall values which can be compared to the Met Office predicted forecasts. This provides the live and historic data required to inform and initiate flood mitigating activities

- **WP2 – Development** – An additional gully alerting module has been created within the existing InTouch Gully Management System. This module takes data feeds from the Smart Streets data hub to analyse potential flooding dangers and at risk gullies. The solution when combined with network maintainer’s local knowledge presents an opportunity for cost savings and efficiencies.
- **WP3 Business Models, Commercialisation and Exploitation** – The business models consideration and development demonstrated that there was significant commercial potential to be delivered from the Smart Gully project, and that the combination of new and disparate data sets has the potential to add value to all parties, including highways maintainers, councils, InTouch, SMEs and other TSB supported projects including the development of an IoT ecosystem. There are many routes to exploit the outcomes as a result of a project which has demonstrated real potential to support the prevention of flooding, via enhanced highways intelligence.
- **WP4 Project Management** – Project Management activities continued throughout the Smart Gully project, following a detailed level 2 plan, continued risk management and weekly reviews as well as weekly communications with the project team to confirm progress and project scope.

Gully probe network

One of the key outputs from this project was the establishment of a network of gully probes across the Redcar and Cleveland area. As discussed in the interim report, initial research was carried out to determine which, out for the 40,000+ gullies in the region, would have the probes installed. The aim was to find which specific gullies in problem areas, would be best suited to represent the other gullies in that area, allowing us to manage a large number of gullies with only a few probes. To do this, data which had been manually collected by the gully cleaning work force and stored in the InTouch Gully Management System was used. All gullies which were found to be 75-100% silted upon arrival by the last cleaning workforce were initially selected. From analysis of these data clusters of problem gullies, specific problem hotspots were identified. In addition to this, knowledge and expertise of contacts at Carillion, who work on these gullies on a regular basis, were used in order to recognise any other known problem areas which may benefit from the installation of a probe. Once candidate areas had been identified, each individual site was visited to assess their suitability for the probe installation and also to assess the surrounding street furniture for their suitability for the installation of the hubs and rain gauges. The locations were reviewed in the presence of relevant members of Carillion and confirmed. Permission was then requested, and subsequently granted, to install the hubs and rain gauges on the lighting columns in Redcar.

Installation of the probes was then performed by Carillion and supervised by a member of staff from InTouch. As part of this, a document describing guidelines on the installation process was generated and then distributed to the relevant parties involved.

Flood Alert Module

The Smart Gully project aimed to more effectively and efficiently inform gully cleaning schedules to prioritise the most likely to flood gullies. By placing innovative probes into gullies we have been able to measure water and silt levels within the gully pots situated in problem areas, and then assign a flood risk rating. By installing this technology in flooding hotspots we are able monitor gully state in real time and schedule cleansing as it is required.

By using the Smart Streets Internet of Things hub as a repository for the data and accessing it through the provided API, it has been possible to pull the required data sets into the InTouch Gully Management System for analysis.

Where a hotspot (usually a cluster of underperforming gullies) has been identified, and a series of gully probes and rain gauges have been deployed, a flood rating is then applied. Each hotspot has a flood rating which is intelligently calculated. In this project, not only are the gullies themselves equipped with smart technology but the controlling software contains intelligent management algorithms which when combined produces a system capable of aiding planning resulting in improved efficiencies and cost savings.

Enhanced Stakeholder Relationships

We have solidified relationships with the key stakeholders through Smart Gully project activities and built upon existing associations with Carillion who have aided in identifying the hotspots and installing the sensor technology and who will continue to use the prototype developed to further

understand the behaviour of gully networks beyond this project. We have leveraged connections with key stakeholders in the Environment Agency and other highways maintenance contracts such as Balfour Beatty and Amey. We have communicated the Smart Gully aims and objectives as well as the outputs in order to gain understanding and potential for exploitation of the solution going forwards. Involvement from these parties has been key to the software output of the project in ensuring that the solution is viable across different contracts and that it meets the ongoing requirements of the Environment Agency.

Redcar and Cleveland Council have engaged fully with the project and are excited to be involved in creating an innovative solution for flood management. This has opened doors for discussions for further innovation and intelligent highways maintenance in this region beyond the Smart Gully project. These enhanced stakeholder relationships have resulted in further research and development grants which aim to build upon the successes of this project.

4. Describe any changes to the original project. What was the reason for these changes? Please include any circumstances that aided or impeded the progress of the project and the actions taken to overcome them.

As was identified in the interim report submitted 21st February 2013, the project suffered delays in probe delivery of 4 weeks due to technical issues with the manufacturer combined with a delayed project start from a delay in contracts being issued. The project monitored this delay closely once it became apparent there were some issues and managed to successfully mitigate against any potential risk to the objectives. Probes were delivered as anticipated in the second half of the project and installed within the Redcar and Cleveland area as they were received. There was no impact to the flood alerting development as the data formats we would be expecting were already known and understood prior to probe installations.

5. Please provide a short factual summary of the most significant outcomes of your work.

Work Package 1 – Hardware

- Identification of flooding hotspots in the Redcar and Cleveland area using manually collected historic gully cleaning records combined with operator local knowledge.
- Identification of probe locations within flooding hotspots in order to use a small number of probes in key gullies to represent the larger geographical cluster.
- An improved understanding of gully networks and the difficulties posed by a lack of standardisation with these assets.
- An understanding of the next generation probe improvements through a lessons learned activity during installation.
- Creation of a set of probe installation guides which can be used to inform others of best practice.

Work Package 2 – Development

- A detailed requirements and design document for the development of the Flood Alert module.
- Creation of an integrated flood alerting prototype within the InTouch Gully Management System.
- An improved understanding of gully behaviours through data analysis.
- Data capable of contributing to improved road maintenance regimes.

Work Package 3 - Business Models, Commercialisation and Exploitation

- An understanding of how the outputs from the flood alerting prototype may be used to improve efficiencies and deliver cost savings.
- A plan for exploitation and commercialisation of the flood alerting prototype.
- Improved relationships with key stakeholders.
- Initial understandings of where value can be delivered for all parties

Work Package 4 – Project Management

- A detailed project plan.
- A detailed risk management matrix.
- A project Interim report which identifies the mid point progress of the project and any potential issues we faced as a project team.
- The Final project report detailing the outcomes at the close of the Smart Gully project.
- A project communications plan to support project management

6. Describe the innovative aspects of the work including any new findings or techniques.

The project has delivered several innovative aspects. Firstly the gully probe itself is a low cost solution combining multiple sensing techniques to measure a variety of parameters within a gully pot. The design provides us with additional and more detailed information on the condition and behaviour of the gully. The second innovative feature of the system is the low cost rain gauge which is directly connected to the hub and installed in the same location providing localised weather information for the areas in which the gullies are installed. All data is then combined with weather forecasting information from the Met Office, enabling highways authorities to make more informed decisions on maintenance schedules. The information from the rain gauges also allows us to compare the Met Office forecasting data to events in these localised areas. The Smart Gully project has developed an innovative software solution which combines manually collected gully state information, live gully probe data, rain gauge data and Met Office data to intelligently inform the gully operators to potential flood risks on the network. As well as using innovative technology as described above, we are using an Internet of Things approach to coalesce these usually disparate data sets in a way which has not been done before, to bring cost savings and efficiencies in the delivery of maintenance services as well as reducing flooding incidents and improving safety on the road network for users.

7. Please give a description of how funds were spent with reference to the original budget and explain any significant variations.

The project had no significant variations to budget with the total spend coming in as anticipated. The project was well planned and forecasted and being of only a short duration, no exceptions or issues have been encountered. As identified in the Interim report there was a delay in the probe delivery but with no project variations.

8. Describe any potential long-term collaborations/partnerships entered into. Please list the company and the role they played in the project.

Despite only being short in duration, the Smart Gully project has included many stakeholders and details of their involvement and potential long term collaborations include:

InTouch - Led the project and has been responsible for project management and communications as well as the core software development of the alerting module. InTouch have identified the locations for the gully probes as well as supported the installation.

Carillion - Provided insights into the requirements of the alerting module and ensured that it is fit for purpose throughout the development. Installations of the sensors were carried out by Carillion crews and any maintenance activities going forward will also involve the same

Redcar and Cleveland Council - Agreed to the installation of probes on their network and through ongoing discussions and the trusted relationships maintained continue to work in close partnership with Carillion and InTouch on innovative projects going forwards.

Other stakeholders include the probe manufacturer who designed, developed and delivered the probes for installation into the gullies. We have developed a good working relationship and will continue to investigate how they can support other innovative technology projects in the future.

Whilst not actively involved in the Smart Gully project, we have leveraged the existing relationships we have with the Environment Agency, Amey and Balfour Beatty Mott MacDonald to gain insight and requirements throughout the duration of the project, to ensure that we have input where it is deemed suitable and also engage with them beyond the project.

9. Please describe how your company has gained from this project. What new business opportunities have been created? Do you expect your company to grow as a result of this project?

InTouch have gained significantly from the project so far in building stronger relationships with stakeholders, a viable flood alerting app, enhanced gully probe network and increased understanding of a real gully management and flooding issue. This has now resulted in the capability of combining weather forecasts with live gully status information which may be used to support the prevention of floods via more informed maintenance planning data (intelligence).

The project has proved the concept of enhanced intelligence via a combination of data and wireless sensing technology and the concept of installing a few probes to represent larger numbers and 'hot spot' problem gully areas. The Redcar & Cleveland area represents 40k gullies within the UK's footprint of 14M, therefore presents a significant opportunity to roll out the principle of addressing these problem clusters across broader areas.

General benefits for InTouch from the project to date include:

- Enhanced understanding of gully systems and processes, i.e. Carillion's gully

management issues and the operational experience of flood management.

- Practical analysis and review of live gully data and the creation of a flood alerting app, informing maintenance of 'flood risk' based on weather forecast and live gully conditions. This is scalable - potential increased InTouch software sales within the UK.
- Incorporation of new data from live sensor feeds and the Met Office into an IoT data hub which supports the UK drive for an IoT strategy and ecosystem.
- Trialling of a new flood management concept and moving towards service flood management provision and improved overall ability to support Carillion and the councils in addressing the flooding issues and associated political agenda.
- Increased PR from recent project presentations on Smart Gully to a local MP and now arranging a presentation to a Minister in this area that will lead to further opportunities.
- Completion of a PR video on Smart Gully to actively promote and engage further stakeholders and potential users.
- Strengthened relationships with all stakeholders and new contacts and networks – which will lead to future work.

New work & company growth

Other parties whom InTouch have now started to work with include the Met Office and the Environment and Highways Agencies, and this project has likely contributed to gaining further TSB funding in the areas of Integrated Transport and the Environment, not merely from 'experience of process', but from understanding further the Highways and Technology sectors with relation to the IoT.

The project has already brought in new revenue for InTouch, in capturing gully data for a number of UK councils. The Smart Gully project will no doubt continue to support company growth, in sales, knowledge and related applications.

10. Describe the potential for exploiting the work. Please identify any new IP which has been filed or for which filing is anticipated.

There are great opportunities to exploit the work from this project, and much of this has been highlighted in the preceding sections. The main area of exploitation is that where we have tested and confirmed that the flooding app; combining the Met office data and the live gully status, provides potential to gain momentum within and beyond this project. This is in providing real operational 'value add' to the highways maintainers in delivering intelligent support within the prevention of floods. Previously, there was little in the way of gully data and intelligence, and with probes now installed and the data from the Met office, there is a clear route to use this combination of data to generate intelligence for highways maintainers. This will deliver potentially a more efficient and effective gully management regime, adding to not only the direct support in the prevention of floods, but to smarter cleaning regimes which likely will result in the reduction of overall cleaning events, due to the live gully data and a predictive flood warning capability.

Examples of routes to exploitation include:

- Flood alert roll out within the InTouch Gully Management System, and offered as an enhanced capability to existing customers.
- Smart Gully PR video on YouTube and distributed within the sector and on the InTouch website.
- Carillion workshops and reviews of the Redcar and Cleveland installation, resulting in business growth within Carillion.
- Workshops with other councils and highways maintainers to demonstrate the app and potential uses. This includes workshops and presentations with Amey and Balfour Beatty who are partners on other TSB supported projects.
- Installation of probes in further test areas (used as a marketing approach) to promote the gully management system in other areas.
- Attendance of tradeshows, exhibitions and networking events to demonstrate the new flood alert capability and benefits so far.
- Attendance and support of University events in business development and SME support. Academic papers and research to promote the project outcomes and also to actively encourage and support SMEs in building apps with the gully and weather data now available.
- InTouch web site enhancements to include Smart Gully and the integration and cross promotion with other TSB and IoT related projects (Smart Clean, Smart Integrated Transport Infrastructure Maintenance, and Smart Streets).

- Further presentations to MPs in gaining support for 'flood management' as a route to promote the application to councils and highways operators.

This is a great opportunity to not only merely sell (license) increased numbers of Gully Management Systems, but to significantly aid in managing the gullies and the processes which positively impact the UK's £1Bn annual highways flooding bill.

11. Please insert additional information that may be pertinent. This may be in the form of text, pictures, diagrams, data, graphs that support the work.