**OR and Oxfam**

**(The OR Society: Joint Third Sector SIG, SORG and CORMSIS Event)**

**Optimisation techniques can now be applied to maximise efficiencies in charity donation.**

A recent presentation given by Tom Cherrett, Associate Professor, Logistics and Transport Planning, Southampton University, illustrated the application of remote monitoring technology and optimisation techniques to collect waste and recyclables more efficiently in urban areas.

Introduced by Chris Potts, Professor of Operational Research in Mathematics, Southampton. Tom Cherrett’s presentation ran for more than one hour. It was replete with detailed slides and information concerning the application of optimisation techniques, OR, remote monitoring and details of problems encountered when implementing remote monitoring installation.

Major charities can spend around 20% of their income on logistics, collecting new donations from donation banks and recycling unsellable textiles via various outlets can be logistics resource intensive. Thus, any methods that can be employed to optimise donation collection and reduce the fuel impact on the environment caused by transportation is desirable and welcome.

OR optimisation technologies are particularly good at solving many of the problems associated with donation banks. We were particularly interested in attending this presentation because it detailed the analysis and implementation of the processes and the problems encountered in a substantial piece of O.R. optimisation work undertaken by Tom Cherrett and his team, for Oxfam.

While the main focus of Tom’s presentation concerned work done for Oxfam, during his presentation, he also had the time to detail some of the processes involved in achieving logistics efficiencies in other organisations.

Primarily though, his talk concerned the implementation of remote sensor technology in donation banks to help organisations like Oxfam more efficiently judge “fill levels” and allocate appropriate times for donation bank collections.

Using the fill levels reported daily, and derived collection strategies using tabu search methods Tom Cherrett’s team had achieved considerable efficiencies and overcome many obstacles associated with donation bank management.

During his talk, he detailed how some unscrupulous individuals had often “raided” donation banks prior to collection to obtain the donations given by the public to charity, for their own personal gain. To illustrate this, he displayed a slide which showed a small child being used by donation thieves to enter donation backs through donation slots and remove contents.

Such despicable acts were all too common, and it was goal of this research to find ways of reducing this type of pilfering. The work undertaken had involved equipping Oxfam banks with infra-red sensors that measured how full the banks were, reporting the data twice daily, with the data being used to schedule collections more efficiently and reduce the incidence of thieving by emptying donation banks before they were tampered with.

University of Southampton researchers developed a specially designed vehicle routing and scheduling algorithm to suggest suitable vehicle rounds based on the remote monitoring data, and select best times for collection as part of a strategy to foil pilfering.

It was understood from studies undertaken, that more frequent collection would result in overuse of logistics resources, especially in the case of collecting from under-filled donation banks. So OR methods were employed to help provide indicators as to more appropriate times to facilitate donation collection.

The proposed routes output by the algorithm used for each day of operation were assessed by Oxfam's transport manager and were adapted, as seen fit, for implementation, taking into account issues such as round balancing, vehicle access restrictions, staff availability and other constraints.

After extensive testing of the remote monitoring equipment and of the algorithm used, the collection system went live in May, 2013 and ran as a trial until the July 2013. The results showed relatively modest time and distance savings (~3%) initially, these being limited by Oxfam's fixed shop servicing constraints.

However, more substantial time and distance savings (up to 25%) were estimated for similar applications where collections could be made at any time. These savings were based on a set of rules that only allowed banks to become eligible for servicing once they had reached a specific fill level.

The fill/collection problem was made more complex by the need for the collection vans to visit Oxfam shops on a fixed schedule basis to remove unsold textiles too. Following live and simulated trials, the results suggested that time and distance savings of up to 30% over the current fixed schedules could be achieved when a minimum bank and shop fill level of between 50% and 60% was used as a collection trigger.

Some of the outcomes from the project are now being developed commercially in the form of a mobile phone app, to allow area managers, shop managers and drivers to communicate and manage collection scheduling in a more dynamic way.

Other benefits included greater flexibility for transport managers working at Oxfam, to schedule *ad hoc* work and offer shops additional collections. The Oxfam drivers benefited too as the efficiencies achieved in logistics and better division of labour meant that sometimes it was possible to finish work an hour early.

Additionally, installation of remote sensors reduced the number of visits to empty donation banks in “slow’ donation areas and allowed the drivers to visit donation banks that were usually at least 60% full.

The work with Oxfam is ongoing, and it is expected that further efficiencies will be achieved with regard to optimisation based on theft probability, further development of a reliable phone based monitoring app, improved bank theft monitoring and appraisal.

Space does not permit a full and detailed report on the content of Professor Cherrett’s presentation here, but we have made a video for download and streaming. This video runs for 1 hour from start to finish. It can be accessed from our website.