



Cities as Forces for Good

Insight



The Internet of Things (IoT) & Solid Waste Management in Suzhou, China

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THE INTERNET OF THINGS (IOT) & SOLID WASTE MANAGEMENT IN SUZHOU, CHINA

A consortium of several private-sector enterprises¹ and Tsinghua University, Beijing, is developing a suite of municipal “waste” collection systems, all based on the Internet of Things (IoT). Unsurprisingly, wireless sensors of the position, status, mass, motion (and more) of the “Things” (other than computers) have been the crucial enabling technologies. “Smart”, and its derivative adjectives, is how we have chosen to label them. And we have reason to be skeptical of them: that they are ever just around the corner, of not quite happening yet in practice.² But this is decidedly not so for the smart markets and smart recycling businesses now emerging in China.

In the city of Suzhou a food-waste recycling system dedicated currently to restaurants employs trucks instrumented with Radio Frequency IDentification (RFID), RFID readers, a weighing instrument, a Global Positioning System (GPS), a video surveillance camera, and wireless monitoring of the truck’s “waste” payload (Figure 1). “Garbage” bins at the restaurants have been fitted with RFIDs and data from all of these devices/sources are made available in real-time through the vehicle integrator and dashboard of the trucks (Figure 2). “Things”, such as oil and water separators upstream in the restaurant, are to be installed (this is presently a matter for negotiation); and other “Things”, such as biogas and biodiesel production downstream of the truck fleet, will also be monitored in real time.

Data transmission is enabled by two modes of communication: GPRS (General Packet Radio Service) and a 3G (third generation) mobile phone system.

¹ The Suzhou Resource Recycling & Development Company, Jiangsu Clean Environmental Technology, and Suzhou ZhongTsing Resources Recycling Technology.

² See Beck M B (2013) “[Sustainability and Smartness: A Tale of Two Slogans](#)”, *Sustainability of Water Quality and Ecology*, **1**, pp 86-89.



FIGURE 1. TRUCKS INSTRUMENTED WITH RFID READER, GPS, WEIGHING INSTRUMENT, AND VIDEO SURVEILLANCE CAMERAS IN SUZHOU



FIGURE 2. VEHICLE INTEGRATOR WITH DASHBOARD IN THE TRUCKS

SMARTNESS BEHIND THE SCENES AND TRANSPARENCY FOR ALL TO SEE

The smartness and intelligence of the Suzhou recycling IoT have a “private” and a “public” side to them. The “private” on-line supervisory management system has a backstage database. Its public face shows in real-time who is generating food waste, how much, and where in the city; the movement of that waste across the city; and activity in the downstream recycling facilities. All may observe this: government officials and policy advisors, the restaurant owners, the recycling entrepreneurs, and the general public. We might call this function the Public Service Module of the system’s supervisory platform. It provides timely feedback on performance to restaurant owners, food-waste recycling and disposal enterprises, and government operators.

But what, one should ask, is all this smartness of the IoT for? Why, exactly, do things have to be so smart? Could we surely not have done just as well without the IoT?

Transparency is the key to the answer.

Food waste continues to have a high recovery value in China. Oil is prominent in the Chinese diet and well worth recovering therefore. Restaurants can accordingly sell their food waste to small, private reprocessing facilities, who will regenerate edible oil (for human consumption) or feed for pigs. This, however, is not allowed by the Chinese government, since it may seriously compromise food safety and aggravate risks to health. The smartness of the IoT enables supervising governments and regulating authorities to know how much food waste is being generated by any given restaurant and to monitor sales thereof to waste recycling and disposal enterprises, hence to acquire an understanding of any anomalies suggestive of improper recycling activities.

In addition, recycling and the disposal operations for food waste from (private) restaurants are subsidized by public authorities. In the case of the city of Suzhou, for example, this subsidy amounts to RMB111.80 per tonne, which, given that nearly some 220,000 tonnes of such waste are generated each year in the city, amounts to a public subsidy approaching RMB25 million (US\$4M) per annum. Inappropriate watering down of the waste can be a commercially attractive prospect. Again, the smartness of the IoT can be deployed to stifle the temptation to engage in any such illicit activity.

Illustrative of other aspects of the Suzhou IoT’s supervisory platform is a Decision-Support Module: for forecasting immediate future trends (over the next few days) of the production of cooking oil residues from restaurants and the output of recovered biogas and biodiesel; for controlling pollution from the biofuel recovery facility; and for maximizing the efficiency of truck-fleet operations.

The recycling IoT is rightly a matter of civic pride. Results of the work of the research team and their opinions and ideas have been published in local newspapers.

BY THE NUMBERS

To gauge the size of the operations of the Suzhou recycling IoT, here are some technical data:

- The population of the city of Suzhou is 5.4M.
- Some 20,000 restaurants are in business in the city and, in principle, are capable of participating in the IoT scheme.
- At the time of writing (July, 2015), the IoT comprises nearly 5,800 participating restaurants, 28 smart trucks and 1 recycling and disposal enterprise.
- The IoT system processes 127,750 tonnes of raw food waste each year (just over half of all such waste being generated in the city), comprised of 18,250 tonnes of waste oil and 109,500 tonnes of solid food waste; it generates just under 11,000 L of biodiesel (valued at RMB 85 million) and nearly 11M m³ biogas (valued at RMB16 million).

Plans are to expand the recycling IoT to cover the entirety of the restaurant system in Suzhou, i.e., to almost double capacity in order to process the 220,000 tonnes of waste being generated.