The impact of failed home deliveries on carbon emissions: Are collection / delivery points environmentally-friendly alternatives?

Julia Edwards¹; Alan McKinnon¹; Tom Cherrett²; Frazer McLeod²; Liying Song³

¹ Logistics Research Centre, Heriot-Watt University, UK
² Transport Research Group, Southampton University, UK
³ School of Traffic and Transportation, Beijing Jiaotong University, China
Phenomenal growth in online shopping

• £22.9 billion spent online in the UK in first half of 2009 (IMRG)
• 69% of shoppers now shop from home (National Statistics)
• >11m Britons shop from home at least twice a week (Shopzilla.co.uk)
• 820 million parcels delivered in 2008 (IMRG)

UK households with internet access
(Source: National Statistics, 2009)
Online shopping: Is it environmentally-friendly? Consumers seem to think so…

Home shoppers give ‘home shopping is good for the environment’ an average score of 6 out of 10

Do you think that online shopping is more planet-friendly than shopping on the high street?
Yes  56%
No   44%
Online shopping: Is it environmentally-friendly?
Some retailers seem to claim so…
But then there is the dreaded failed delivery...

“I’ve been internet shopping”
Failed delivery: the consequences

- The customer is inconvenienced;
- The carrier incurs additional costs;
- There are wider environmental impacts, owing to additional vehicle trips.

“Anyone who believes that time is merely an abstract concept, never waited in all day for a delivery...”
Research aims of this study

To assess (on a per drop basis):

1. Additional gCO₂ produced when a failed parcel requires re-delivery by the carrier;

2. Additional gCO₂ produced when a customer travels to the local depot to collect an undelivered order;

3. gCO₂ savings from the use of alternative collection / delivery points (C/DPs).
Consumer concerns re. home delivery

**Do delivery concerns ever prevent you from shopping online?**
- YES 31%
- NO 69%

**Have you ever had an inconvenient delivery?**
- YES 35%
- NO 65%

**What is the most frequent reason deliveries are not successful on the first attempt?**

- No one is home to receive: 54.9%
- Signature required: 6.3%
- No choice of delivery slot: 14.8%
- Delivery didn’t arrive as promised: 13.4%
- Online tracking and actual delivery don’t match: 0.7%
- Parcel delivered to the Post office/depot: 1.4%
- Other (please specify): 8.5%

Is there normally someone at home to receive deliveries in the daytime?
- YES 75%
- NO 25%
## Research Aim 1: Delivery failure rate

### First-time delivery failure rate: assumptions

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>after McLeod &amp; Cherrett (2006), Song et al. (2009) &amp; Belet et al. (2009)</td>
</tr>
<tr>
<td>50%</td>
<td>after Retail Logistics Task Force (2001)</td>
</tr>
</tbody>
</table>

### Second-time re-delivery failure rate: assumptions

| 50%    | after McLeod & Cherrett, (2009)                    |

Would you be happy for a neighbour to sign on your behalf?

<table>
<thead>
<tr>
<th>YES</th>
<th>84%</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>16%</td>
</tr>
</tbody>
</table>
Successful first-time delivery: Emissions for an average non-food home delivery

**Assumptions**

- Round trip (miles) 50
- Drops per round 120
- Items per drop 1

**CO₂ per drop** 181g

* Average values, calculated from 4 sources: Defra; NAEI; FTA; RHA
Failed delivery: Emissions (gCO₂) per item

<table>
<thead>
<tr>
<th></th>
<th>100% successful first-time delivery</th>
<th>10% failure rate</th>
<th>30% failure rate</th>
<th>50% failure rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home delivery</td>
<td>181g</td>
<td>199g</td>
<td>235g</td>
<td>271g</td>
</tr>
</tbody>
</table>

First-time delivery failure “as a delivery for which a signature cannot be obtained, either from the customer or a designated customer representative, & this results in the customer's address being carded & the item returned to the delivery depot for either redelivery or customer collection”. (IMRG, 2008)
Re-delivery factoring in a 50% failure rate: Emissions (gCO$_2$) per drop

<table>
<thead>
<tr>
<th></th>
<th>First delivery attempt failure rate (plus 50% 2$^{nd}$ delivery failure)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10% failure rate</td>
</tr>
<tr>
<td>gCO$_2$ per drop</td>
<td>208g</td>
</tr>
<tr>
<td>% increase over base case</td>
<td>15%</td>
</tr>
</tbody>
</table>

And when the 2$^{nd}$ delivery attempt fails…
If a delivery fails, how long does it take you to collect an item?

- 18.3% < 10 minutes
- 39.1% Up to 30 minutes
- 21.0% Up to an hour
- 4.8% Two hours
- 1.5% Three hours or more
- 15.2% I've never had to collect a failed delivery

Distance to local depot & trip chaining: Research assumptions

<table>
<thead>
<tr>
<th>Distance</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>15km</td>
<td>after Clements (2005)</td>
</tr>
<tr>
<td>25km</td>
<td>after McLeod &amp; Cherrett (2009)</td>
</tr>
<tr>
<td>40km</td>
<td>after Song et al. (2009)</td>
</tr>
<tr>
<td>50%</td>
<td>distance allocated to collection of failed delivery (realistic assumption)</td>
</tr>
</tbody>
</table>
Research Aim 2:
Emissions (gCO$_2$) per consumer trip to a local depot to collect an undelivered order

<table>
<thead>
<tr>
<th>gCO$_2$</th>
<th>Distance to local depot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15km</td>
</tr>
<tr>
<td>Car</td>
<td>3,113g</td>
</tr>
<tr>
<td>Bus</td>
<td>1,340g</td>
</tr>
</tbody>
</table>

26 re-delivery attempts
Research Aim 2: Emissions (gCO$_2$) per delivery & consumer trip to a local depot (%)

Assumes:
30% of first-time failed deliveries fail and 50% of second delivery attempts also fail;
A customer travels 25-km to a local depot to collect an undelivered order
Alternative collection / delivery locations (C/DPs)

Would you opt for a delivery location option of your own choice?

YES 40%  NO 60%

Where would you be likely to choose?

- Local newsagent: 31.4%
- Petrol station: 11.8%
- Convenience store: 14.2%
- Secure box near where you live: 18.6%
- Other: 24.0%
### Research Aim 3:
Location, distance & advantages of C/DPs

<table>
<thead>
<tr>
<th>Location</th>
<th>Distance (km) from av. consumer's home</th>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tesco Extra</td>
<td>6.5</td>
<td>24-hr opening times, familiarity, regular destination</td>
</tr>
<tr>
<td>Other supermarket</td>
<td>1.6</td>
<td>Extended hours, proximity, regular destination</td>
</tr>
<tr>
<td>Average supermarket</td>
<td>4.0</td>
<td>24-hr / extended hours, regular destination</td>
</tr>
<tr>
<td>Post office</td>
<td>1.2</td>
<td>Proximity, familiarity, regular destination</td>
</tr>
<tr>
<td>Railway station</td>
<td>3.2</td>
<td>Convenient for rail users / daily commuters</td>
</tr>
</tbody>
</table>
Research Aim 3: Emissions savings (%) per consumer trip to alternative C/DPs versus traditional delivery

<table>
<thead>
<tr>
<th>Location</th>
<th>CO₂ per av. drop (incl. additional km to C/DP)</th>
<th>CO₂ for consumer trip to C/DPs</th>
<th>% CO₂ per C/DP compared with traditional delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tesco Extra</td>
<td>204</td>
<td>1,349g, 581g</td>
<td>47%</td>
</tr>
<tr>
<td>Other supermarket</td>
<td>186</td>
<td>332g, 143g</td>
<td>16%</td>
</tr>
<tr>
<td>Average supermarket</td>
<td>195</td>
<td>830g, 357g</td>
<td>31%</td>
</tr>
<tr>
<td>Post office</td>
<td>185</td>
<td>249g, 107g</td>
<td>13%</td>
</tr>
<tr>
<td>Railway station</td>
<td>192</td>
<td>664g, 664g</td>
<td>26%</td>
</tr>
</tbody>
</table>
Conclusions

1. Additional CO$_2$ from the second delivery attempt increased the emissions per drop by between 9 - 75%.

2. Vast majority of emissions associated with traditional failed delivery arise from the personal trip to the local depot. (Worst case scenario equivalent to 26 re-delivery attempts by delivery van).

3. Supermarkets, railway stations & post offices each offer distinctive benefits for consumers, & all lessen the CO$_2$ emissions from failed home deliveries. (Post offices, owing to their extensive network, present the greatest savings).
Contact details

Logistics Research Centre
Heriot-Watt University
EDINBURGH, UK

J.B.Edwards@hw.ac.uk

http://www.sml.hw.ac.uk/logistics

www.greenlogistics.org.uk