'I want it now' – Understanding the logistics impacts of students' online shopping habits in halls of residence and the opportunities for consolidated parcel delivery services

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Abstract

Growth in online shopping has led to increased numbers of small delivery vehicles in urban areas leading to a range of negative externalities. Young people are significant generators of home deliveries and when clustered in university halls of residence, can generate considerable freight traffic to one location. This paper explores the potential to consolidate these deliveries using an urban consolidation centre. Based on the case of Southampton, UK, data were compiled from three linked sources: a delivery audit of four halls of residence at University of Southampton housing 5,050 residents; annual package receipt records from Southampton Solent University halls (2,294 residents); and an online shopping survey distributed to Southampton University students (486 responses). The results suggest that in cities with multiple higher education institutions (HEIs), where in excess of 8,000 students live in halls, over 13,000 courier trips could be generated annually, delivering over 4,000m^3 of packages. These could be consolidated onto less than 300 vehicles for an annual service cost of approximately £18 per student, reducing congestion, parking infringements and improving air quality. Analysis indicated student acceptance of a consolidated parcel service but operational challenges would include enforcement, performance risk, finance and delivery speed.

Keywords
E-Retail; Consolidation Centres; Home Delivery; halls of residence

1   Introduction

Freight transport makes up 16% of all road vehicle activity in UK cities, with lorries and vans performing 30% of their work load in urban areas (Department for Transport, 2015). Over the last ten years, van traffic has increased by almost a fifth while all other types have shown overall decreases, (Browne et al., 2014; Department for Transport, 2015). A key reason for this is the growing demand for new ways of buying goods and fulfilling deliveries. Online shopping has grown from 3% of total UK retail sales in 2007 to over 16.8% in 2015 (Cherrett et al., 2012; Retail Research, 2016) and alongside this, just-in-time procurement has resulted in increasingly less-efficient small-package flows (Ofcom, 2015). A key generator of this freight activity are younger age groups who now do proportionally more of their shopping online than any other with 42% of 18-24 year-olds in 2014 declaring it as their major purchasing medium (Statista, 2016). Given that around 27.5% of the 1.4 million full-time UK undergraduate students live in halls during term-time (Higher Education Statistics Agency, 2015; Seock and Bailey, 2008), university student accommodation could be a

significant freight generator in its own right. While studies have indicated a CO_2 advantage for home delivery compared to the traditional high-street shopping trip (Edwards et al., 2010; Goodchild et al., 2016), most omissions accrue during the 'last mile' (Edwards et al., 2010; Wiese et al., 2015). This could be eroded further where large numbers of customers residing in the same complex, such as a university hall of residence, can all order independently with no penalty for generating separate deliveries.

Urban Consolidation Centres (UCCs) have long been seen as a way for local authorities to alleviate the negative impacts of last-mile freight operations (Savelsbergh and Van Woensel, 2016) by grouping deliveries onto smaller numbers of less polluting vehicles. Results suggest that they have often failed to make the impact expected due to difficulties attracting clients and issues of longer term financial viability (Allen et al., 2012). Of interest in this research is whether a new market for UCCs exists in helping to better manage the movement of private deliveries to students living in halls of residence, particularly in cities where multiple higher education establishments exist.

With this in mind, we make three contributions in this paper: firstly, we quantify the scale of student e-retail activity through an audit of packages received across the halls of residence at the University of Southampton, UK, during the week after Black Friday (27/11/15); secondly, we investigate the behaviour behind this activity through a structured questionnaire survey of students living in halls (n=405); finally, working with the operator of a UCC serving the city of Southampton, (Meachers Global Logistics), we use both studies and data from Southampton Solent University to propose how halls post could be consolidated and quantify the costs and issues associated with doing this via a UCC.

2   Background

2.1   On-line purchasing habits and impacts on logistics

People are shopping and spending more online with several reasons driving this consumption: continued rising ownership of computers and mobile devices (e.g. smartphones and tablets); improved internet connectivity; and greater desire to hunt for convenience and monetary value (savings) due to longer working hours, less leisure time and/or lower disposable income (Mintel, 2015a and 2015b). The prevalence of online shopping continues to disrupt the business models and logistics of varied retail sectors (e.g. grocery and fashion). Online shopping is turning physical retail stores, such as those in the consumer electronics sector, into 'showrooms' where people browse and inspect goods but do not necessarily buy (Wenig & London, 2014). Moreover, online shopping is also pushing retailers to introduce new or innovative services that are either free of charge or seen as highly desirable to their online customers, such as speedy delivery services (e.g. same-day delivery), subscription for unlimited delivery (e.g. Asos's Premier Delivery), click and collect service (e.g. Collect+), self-service lockers in handy locations (e.g. Amazon Lockers in shopping centres), or flexible return procedures for items bought online (e.g. return by post, by courier or to a physical store), Mintel, (2015b). Being able to choose delivery slots with no minimum spend are also becoming common expectations of online shoppers (Mintel, 2016).

Young people, especially those aged between 18 and 34 years make up a significant sector of online retail customers and are known for their frequent online shopping (ShopperVista, 2016), driven by

the ease, convenience, speed, and money-saving opportunities (ShopperVista 2016). Young people's enthusiasm for online shopping can be also fuelled by their 'live for today' and 'enjoy every moment' consumer values (Passport, 2013 and 2015). Young people are more inclined to make 'spur of the moment' unplanned purchases, feeling more deserving of their purchases than older consumers (e.g. their parents) (ibid). Shopping online provides young people with a major 'life hack' to their hectic lifestyles and by simply possessing a computer or a mobile device connected to the internet, they can perform varied shopping activities with great efficiency, reducing the time and effort required to visit a physical store (Mintel, 2015a and 2016).

As a result, the courier and express services market in the UK was estimated to be worth approximately £158.74bn in 2014 and is projected to grow to £10.69bn by 2019 with the anticipated growth in on-line retail, representing 26.7% growth from 2010 (Keynote, 2015). With approximately 1.065 billion parcels delivered across the UK during 2015, of which an estimated 260 million were handled during November and December (IMRG, 2015), the impacts of home delivery on logistics and personal travel could be considerable but are not well understood. It has been suggested that general fragmentation in the retail sector resulting from retailers offering ever more service variants to consumers could lead to more freight vehicle movements, particularly where crowd-sourced couriers are employed. In contrast, more delivery options and mechanisms made available to consumers (particularly the potential for unattended delivery) might result in changes in travel behaviour and fewer personal car journeys being made (Visser et al., 2014). Problems experienced by consumers with online retail have been largely related to delivery with 15% stating that no-one was in to receive the item when it arrived, 13% reporting delays in delivery and 3% having to make a collection from a courier's depot in response to a failed first-time delivery (Eurobarometer, 2013; Morganti et al., 2014).

2.2 Urban Consolidation Centres and their role in reducing last-mile delivery impacts

Urban Consolidation Centres (UCCs) are secure warehouse or cross-dock facilities which allow multiple deliveries of consignments destined for various customers within an urban area to be consolidated together into fewer vehicles for the final leg of their journey (Browne et al., 2005). They have been in operation since the mid 1970's across Europe with over 114 schemes having been identified across the retail, office, residential and construction sectors (Allen et al., 2012). UCCs can be divided into three basic types (Allen et al., 2012; Triantafyllou et al., 2015): i) *UCCs serving all or part of an urban area* (often instigated by a local authority and associated with the supply of retail and office products to specific urban districts suffering from transport-related problems); ii) *UCCs serving single-landlord sites* (typically managing retail products and supplies for airports, shopping centres and hospitals where minimising the need for on-site storage to maximize retail/operational space is of primary importance). In this case, the UCC can either be 'suggested' by the landlord, where an incentive of additional storage space and services is given to those retailers signing up to use the UCC or 'demanded', as a condition of the rental contract (e.g. London Heathrow) (Browne et al., 2005); and iii) *Construction UCCs* designed specifically to handle construction materials.

Where they have been instigated by a local authority, a key motivation has been to reduce the numbers of freight vehicles operating within the urban area (Browne et al., 2005) and reported reductions in vehicle trips and kilometres travelled have been between 60% and 80%, with

associated reductions in greenhouse gas emissions of between 25% to 80% (ibid). One of the more significant schemes was introduced in Japan (1994) where 36 individual logistics providers signed up to a public-private partnership with the national and regional government in Fukuoka City, using a UCC to serve the central business district (CBD). The regional government also enhanced parking facilities for freight vehicles which resulted in a 65% reduction in the number of freight vehicles in the CBD and 87% in their associated km's travelled (OECD, 2003). UCCs have also shown to greatly improve load consolidation and the ability to reduce the numbers of freight vehicles over the last-mile has had positive effects in reducing the space and time taken up by delivery vehicles at the kerbside (Boudouin, 2006; Browne et al., 2005; Gonzalez-Feliu & Morana, 2010; WSP, 2008 in Allen et al., 2012).

A major issue has been their long-term financial viability with some believing that they may only be suited to specific controlled environments, or 'captive markets' where users are compelled to co-operate, such as construction sites or where strict landlord-tenant relationships exist (Kin et al., 2016; van Rooijen and Quak, 2010; Zunder and Marinov, 2011; Allen et al., 2012) as is the case with university accommodation. The reason behind this is the additional link added into the supply chain which is viewed as an additional cost (McKinnon, 1998; Marcucci and Danielis, 2007), and many UCCs have only materialised and continue to operate with the aid of public subsidy (Verlinde et al., 2012; Browne et al., 2005). Despite this, with local, national and European governments particularly concerned about vehicle emissions and air quality standards, UCCs are seen as a major aid to achieving sustainable urban freight logistics in the long-term (Savelsbergh and Van Woensel, 2016).

2.3 Higher Education Institutions – a potential market for UCCs?

From the considerable literature on UCC trials, the majority have been focussed on retail operations (Browne et al., 2005). Although other sectors have been highlighted as applicable (e.g. office developments, service organisations, leisure complexes), little attention has been paid to the scope for large municipal organisations (higher education institutions, hospitals, local authorities) to reduce their logistics footprints by adopting consolidated deliveries.

Higher Education Institutions (HEIs) are major centres of commerce in cities across the UK and often make up one of the largest regional employers (Wells et al., 2009). In 2013/14, 2,299,355 students registered across 162 UK HEIs (1,759,915 undergraduates and 539,440 postgraduates), overseen by some 395,780 academic and non-academic staff (Higher Education Statistics Agency, 2015). The total income generated across the sector was £30.7bn which would position it fourth in the FTSE 350 top revenue (Association of University Directors of Estates, 2014). Investment in the HEI estate increased by 9% to over £2bn in 2013/14 (ibid) and its servicing, along with the management of the taught student programmes and research activities results in significant volumes of goods and service vehicles visiting HEIs on a daily basis. The procurement processes adopted by HEIs can be highly varied and complex given the different departmental structures that can exist (Casu and Thanassoulis, 2006) with key areas of delivery activity emanating from central services (including central university administration, general education, staff and student facilities, management of research grants and contracts, estates and facilities management, libraries, residences and catering operations) but also through individual departments.

An investigation into delivery activity emanating from the procurement process at Newcastle University (Zunder et al., 2014) suggested that 1,058 staff out of 5,000 were recognised requisitioners across 144 schools/departments and suppliers often operated a 'next-day' delivery service as a default due to a lack of clear delivery requirements. In terms of freight vehicle activity,

162 freight vehicles were observed per day at four key locations around the campus, 82% of which were classified as 'light goods'. The impact on delivery activity at HEIs can be further influenced by specific requisitioners holding purchasing cards (credit cards that allow goods and services to be purchased without the need to raise a purchase order) and staff having personal deliveries sent to their place of work. The scale of procurement and associated delivery activity is such that a UCC option could considerably reduce vehicle impacts into HEIs, particularly when the opportunities for managing returns and recyclate are factored in.

Of interest in this paper is the specific impact of personal deliveries on HEI residencies (or 'halls') which is an under researched area. Traditionally, first year undergraduates take a place in a hall of residence and these often large, multi-occupancy developments form a key element of the estates of most HEIs in the UK (Mcleod et al., 2016). Given that many UK HEIs have student populations in excess of 20,000, this can result in a cohort of around 4,000 to 8,000 students living in such complexes during term time. During the 2013/14 academic year, there were thought to be around 385,000 students living in halls at UK HEIs (Higher Education Statistics Agency, 2015) and given their propensity to order online (Statista, 2016; Seock and Bailey, 2008), halls of residence could increasingly become major generators of freight activity in their own right and could be an ideal candidate for consolidated deliveries via a UCC.

The model most aligned to this would be a UCC serving a 'single site', where the HEI acts as the landlord, 'demanding' that couriers deliver into the facility (Browne et al., 2005; Panero and Lopez, 2011), and that students use it as a default address when ordering on-line. The costs of the UCC service could be covered in the annual halls fee levied to the students or potentially via savings in the university's human resource costs needed to manage package receipt. With couriers taking deliveries into the UCC, consolidated loads could be made and delivery times negotiated with halls to better suit reception staff, particularly where residencies do not operate 24-hour porterage. The off-site management of packages could free up halls reception space and also reduce the disruption and, potentially, the labour requirements associated with receiving multiple deliveries randomly throughout the day, leading to improvements in staff planning and productivity at residencies.

Student acceptance of a consolidated delivery service is critical to its long-term success and a concern is the rise in same-day delivery services which, if popular, could greatly hinder uptake. Potential success also hinges on logistic providers' and retailers' support for the UCC concept which has implications for responsibility of items in transit, especially when delivery options require a signature. While there has been some work on young people's online retail behaviours (Passport, 2013; 2015; ShopperVista, 2016), there is currently relatively little known about young people's delivery preferences, a key factor influencing their shopping habits.

With the pressure on HEIs to improve their environmental and ethical performance (People and Planet, 2015; Universities UK Efficiency and Modernisation Task Group, 2011), along with the need for local authorities to reduce CO_2 from logistics activity in urban areas, there is an opportunity to investigate how UCCs could be used for mutual gains. The true extent of parcel delivery to HEI halls and the opportunity for consolidation is not well understood and was the motivation behind this research.

2.4 Perceptions of trust and risk in online shopping potentially influencing the introduction of UCCs into the supply chain

Online shopping behaviour differs from the purchase of products in-store as the process is mediated in various respects. Consumers have to engage with a supplier online and trust the supplier will provide the product, the product will be delivered by a third party organisation and product

gratification is not immediate. The absence of face-to-face presence during the transaction therefore presents a number of fundamental transaction concerns related to trust, responsibility for delivery, speed and cost of delivery.

Trust is a diverse concept that can be considered as generalised trust in society or communities, or as personalised trust (Flavián et al., 2006; McKnight et al., 1998; Vidotto et al., 2012). Lack of trust is a fundamental reason why consumers fail to carry through online purchases (Kim and Park, 2013) where trust is focused on the company with whom the consumer makes the original transaction; however, it can be extended to third parties involved in the delivery. This is a form of personalised trust which relates to known individuals or, in this case, institutions. Trust is typically analysed in terms of honesty, benevolence, competence and predictability (McKnight et al., 1998) and in online transactions, all four aspects of trust are relevant in the initial purchase decision. In this context, honesty reflects the belief that a company will fulfil its promises to deliver the item ordered online (Kim and Park, 2013). Benevolence is the belief that the other party will not act opportunistically and in online transactions the company actions do not compromise the consumer's wellbeing (ibid).

With respect to a consolidated delivery service, the competence and predictability aspects of trust are most relevant. Competence refers to the trusted party having the relevant skills and ability to undertake a specific task (Flavián et al., 2006; Vidotta et al., 2012). Earlier work on online retail suggests consumers can be insecure about conditions of delivery (Flavián et al., 2006) and this will be heightened by an additional link added to the delivery process. Competence therefore reflects whether the HEI and a third party urban consolidation centre, in the opinion of the shopper, have the financial, technical and human resources (Flavián et al., 2006) necessary to operate a consolidated delivery service. Additionally, predictability reflects the consumer's trust in a delivery arriving as forecast by the vendor (Vidotta et al., 2012).

Perceived risk in the transaction is another important component of online purchase decision making (Chaparro-Peláez et al., 2016) where risk is defined as a composite of "the probability of negative consequences occurring and the importance of negative consequences" (Shin et al., 2016, p. 191). Risk related to online shopping has mostly been analysed in relation to payments, sharing personal information, product satisfaction and delivery concerns. Payment concerns and the use of personal information represent a security and trust issue which is of greater concern among older consumers (Mintel, 2015c). If a purchase is considered low risk, for example due to low cost, then risk can be largely ignored as a factor in the transaction. Risk in online retail has therefore also been related to product characteristics with research indicating price and degree of involvement needed by the consumer in the product evaluation increase purchase risk (Sinha and Singh, 2014).

In recent studies, there are conflicting findings about delivery risk. Chaparro-Peláez et al., (2016) found delivery risk to be less of a barrier to online retail compared to other risks, however, Ofcom (2015) found 45% of online consumers had concerns about deliveries mostly related to cost and delivery time, though poor previous experiences were also an issue. A consolidated delivery service is likely to increase the perceived delivery risk with respect to damage to or loss of goods in transit and delivery timescales. This adds an additional performance risk (Shin et al., 2016) to the transaction, however, Ofcom (2015) found that few consumers (11%) were concerned about the delivery provider so long as this did not impact on cost and delivery speed. It was also found that

consumers liked delivery notifications and tracking (ibid) which may be compromised by a consolidated parcel service.

Speed of delivery and knowledge of delivery timescales are important to online purchase decisions since consumers experience a delay in the gratification from product acquisition (Ofcom, 2015; Park and Kim, 2007). This also represents a time risk (Park and Kim, 2007) with studies suggesting that reducing delivery times can be as important, or more important, than product cost, however, speedier deliveries increase logistics costs and have implications for profit margins if costs are not passed onto consumers (Hua et al., 2010). Ofcom (2015) found that free delivery was an important factor when choosing a retailer but that 60% of consumers did not want to pay for upgraded services, despite the growth in non-standard delivery formats.

3 Methodology

To investigate the impact of personal deliveries at HEI halls of residence and the scope for a consolidated delivery service using a UCC, data from the University of Southampton and Southampton Solent University were used. Southampton is a city on the south coast of the UK with a population of around 250,000 and is home to two universities, both situated within the central urban area. The University of Southampton is situated towards the northern end of the city, around 4km from the city centre and has eight halls of residence (Figure 1), accommodating 6,592 students from a total student population of just under 25,000. Southampton Solent University is located in the city centre and has 6 halls, accommodating 2,294 students, out of a student population of more than 19,000, although many study part-time and live locally. All first year students are guaranteed a place in a hall subject to terms and conditions.

To investigate the impact of personal deliveries at halls of residence and the scope for a consolidated delivery service using a UCC, data were used through three linked activities:

3.1 Halls delivery audit

Using four of the eight halls of residence at the University of Southampton, a 5-day delivery and service activity audit was undertaken to coincide with the week immediately following the Black Friday retail event, 27th November 2015, (Saturday 28/11/15 - Friday 4/12/15) using surveyors stationed in the reception areas of each hall of residence between 09:00 and 17:00. Surveys comprised observations of deliveries and a brief interview with delivery drivers and followed the standard audit procedure set down for undertaking delivery and service plans (Transport for London, 2016). The data recorded included arrival and departure times of couriers, the vehicle origin point, number of drops on the round and the next drop point in the sequence, the number and sizes of packages delivered, whether any deliveries were subject to time window constraints and the vehicle details (vehicle type and registration plate). Recording the latter allowed subsequent analysis of how many different vehicles were used by the main carriers to service the halls. A small number of deliveries were made at other times of day (e.g. shortly before 9am or shortly after 5pm) some of which were noted by reception staff and reported to the returning surveyor the following day.

Goods-in data were also obtained from Southampton Solent University for five of their six halls using their bespoke parcel receipt software system, covering a period from mid-September 2015 to mid-July 2016 (very few packages for students would be expected during the summer vacation). This

provided similar data to that obtained via the delivery and service audit, but with no vehicle details recorded, and allowed a more detailed investigation of seasonal trends in package receipt. These audits were used to quantify the extent of freight vehicle activity at halls, specifically related to student purchasing during peak and off-peak periods and the types of delivery service used. The seasonal trends observed from Southampton Solent University were also assumed for the University of Southampton and data were also extrapolated to consider the halls that were not surveyed, based on numbers of students residing in each hall.
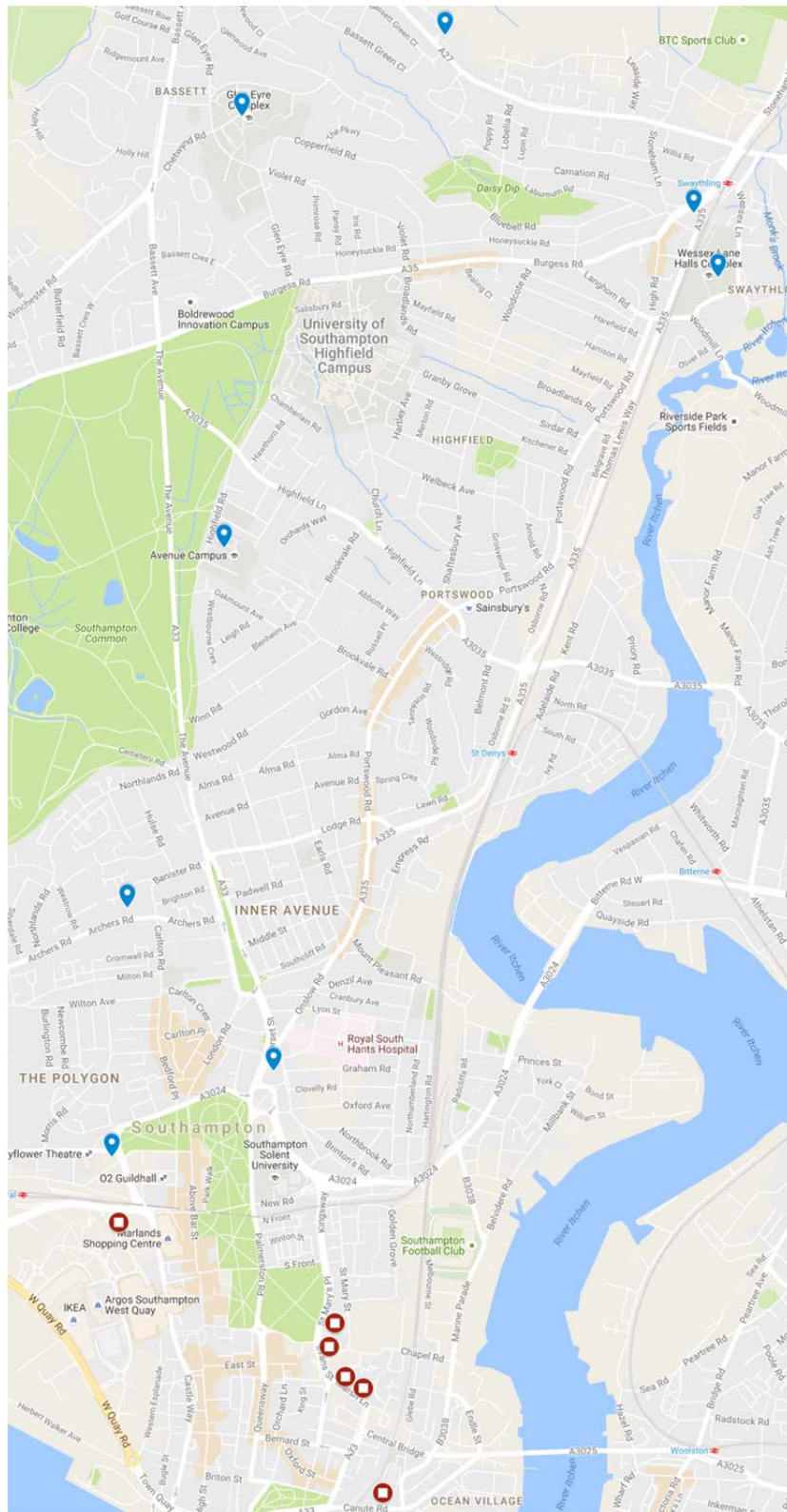
Figure 1. Locations of university halls of residence in Southampton

(Key: Pin =University of Southampton; Circle = Southampton Solent University)

3.2 Halls of residence online shopping survey

An online survey was developed for distribution to students residing in halls. This was divided into four sections covering: current online retail and delivery practices; opinions on a consolidated delivery service to halls; online retail habits during the 'Black Friday' sales week which took place the week prior to the survey distribution; and personal information.

In order to understand current online retail and delivery practices, respondents were asked to indicate the frequency of products ordered (based on product categories from Mintel (2015c)) for delivery to halls on an 8-point scale from 'never' to 'more than once per week' and the frequency of the delivery options chosen. This was followed by a series of Likert-type questions ('strongly agree' to 'strongly disagree' on a 5-point scale) addressing attitudes towards delivery options which focused on time, cost and convenience. The week following Black Friday was chosen as the focus, being the busiest on-line retail period of the year and for ease of recalling actual purchases made over the previous 7 days.

To explore the scope for reducing deliveries to halls, the concept of a consolidated delivery service was explained to respondents as follows: *"One concept designed to reduce the amount of delivery vehicles visiting our halls of residence each day is to have a local warehouse act as the default delivery address which you would use when placing orders with non-food retailers. The warehouse would consolidate all the parcels destined for each hall and deliver them at a set time each day on one vehicle."* Respondents were then asked to complete a series of Likert-type attitude questions ('strongly agree' to 'strongly disagree' on a 5-point scale) related to their views on this concept. These focused on trust, responsibility for goods, speed and cost of delivery, and one question on environmental concerns.

The trust statements focused on the 'competence' component of trust and were adapted from the scale developed by Flavián et al., (2006). In terms of responsibility for goods, questioning focused on concerns about who would be liable for any damage or losses once goods had been signed over to the UCC from the courier. Three items focused on speed of receipt (which is also aligned with the predictability aspect of trust) and the time critical aspects of delivery. An item measuring 'present hedonistic' tendency was derived from Zimbardo's time perspective inventory ('I find myself getting swept up in the excitement of the moment'). This relates to hedonistic patterns of consumption identified among young people (Stanes et al., 2015). Two items focused on a combination of speed and cost as cost is often relative to the speed of delivery options. The personal information section asked for data on gender, fee status (home/EU and international students) and hall of residence (to indicate location). Age data were also collected, however, given halls of residence are typically for first year students there was little variation in age so this was not considered further in the analysis.

The questionnaire was distributed online during the first two weeks of December 2015 following Black Friday on 27th November 2015. Distribution was via an email database of all students residing in halls of residence at the University of Southampton (n=6,592) with 486 questionnaires returned of which 405 (6.1%) were completed in full and considered for analysis. Women were over represented in the sample (60%) which may reflect a gender bias towards completing a questionnaire about shopping and the sample included 75% home/EU students and 25% international students defined by fee status.

3.3 UCC halls post service evaluation

The final part of the methodology involved using the goods-in data from Southampton Solent University and knowledge gained from the questionnaire on student preferences to determine how a halls post consolidation service operating out of an existing UCC in Southampton would function. The analysis was also informed by working with the operator (Meachers Global Logistics) to quantify the likely costs, strengths, weaknesses, opportunities and threats.

4 Results – Halls delivery audit

The halls delivery audit at the University of Southampton gave a first insight into the scale of personal delivery activity at halls and the associated problems faced by reception staff in managing it. The parcel delivery and management system in the halls comprised of the following elements:

- Deliveries were made by couriers to the hall's reception desks which were manned 24 hours a day. Some of the smaller halls did not have their own reception point and in these cases, their post was diverted to a neighbouring hall.
- Parcels were only accepted by the reception staff if the named recipient was resident at the hall. This involved checking the consignee on a computer system and logging the accepted items has having been received. This process proved rather time-consuming when large consignments were delivered with couriers having to wait for each individual item to be checked.
- Parcels were kept in a storage area behind the reception desk.
- An automated email was sent by the computer system at 17:00 each day to inform students that the reception team were holding a parcel for them. The University policy was not to release any parcel in advance of this email having been sent. (N.B. Students may have already been informed of the delivery by the courier before this point through the couriers parcel tracking service).

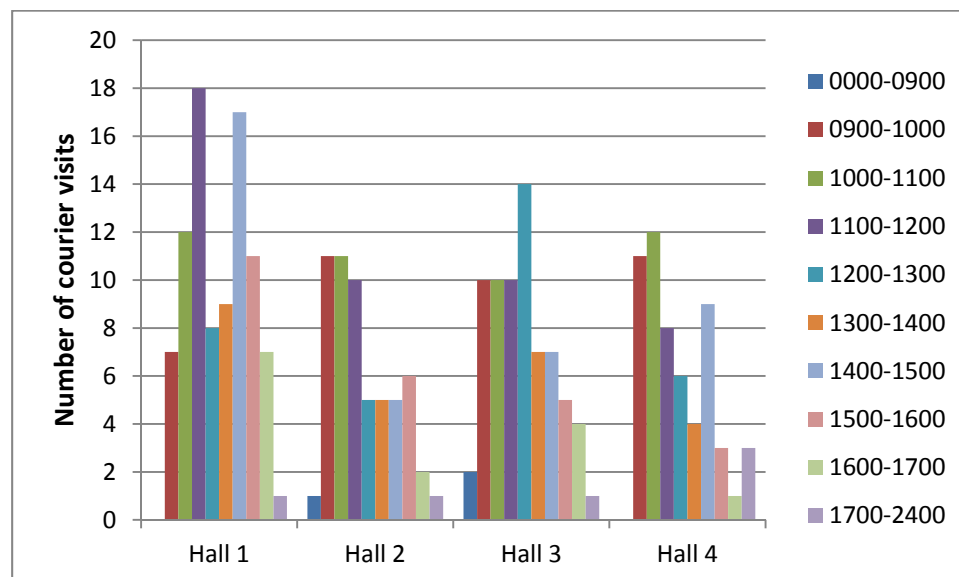### 4.1 Numbers of observed courier visits

Across the four main halls of residence at the University of Southampton serving a total of 5,050 residents, 275 freight vehicle visits were observed over the 6 day survey, delivering packages for students with the largest hall receiving between 14 and 18 visits daily (Table 1). Saturday was the least busy day (34 visits), while weekdays saw a fairly even spread of between 45 and 51 visits in total across all four sites. In many cases, the same courier company and the same driver were observed visiting the same hall daily and occasionally, twice on the same day. Carriers that were regularly observed (number of visits across the four halls in brackets) were: Yodel (29), DPD (26), Royal Mail (24), DHL (23), Hermes (20), Parcelforce (19), UPS (19), Amazon (16), Interlink (14), DX (13), with a total of 30 different logistics companies observed making parcel deliveries to the halls during the survey. From the vehicle registration plate analysis, Amazon used the most vehicles (9), followed by Yodel (7), Hermes (6), Interlink (6), Parcelforce (5), Royal Mail (5), UK Mail (5), with other carriers using fewer vehicles.

Table 1 – Number of courier visits (busiest days shown in bold) observed at four University of Southampton halls of residence between Saturday 28/11/15 - Friday 4/12/15, 09:00 to 17:00.

| Hall (#residents)	Sat	Mon	Tue	Wed	Thu	Fri	Total
Hall 1 (1900)	14	**18**	14	15	15	14	90
Hall 2(1700)	6	10	**15**	7	8	11	57
Hall 3 (1100)	9	10	13	**16**	11	12	71
Hall 4 (350)	5	9	9	**12**	11	11	57
Total (5050)	34	47	**51**	50	45	48	275

4.2   Delivery times and durations

When looking at the distribution of vehicle arrivals during the day, couriers were observed arriving at each hall throughout the main survey period (9am to 5pm), but particularly between the hours of 09:00 and 13:00 (Figure 2). At the largest hall (Hall 1; 1,900 residents), there were approximately the same numbers of visits before 1pm as after, while at the other three halls, there were around twice as many deliveries before 1pm as after. One of the main advantages of adopting a consolidated delivery service for halls post would be to move away from this continuous stream of deliveries to a single one at a pre-specified time, allowing better staff time management.

Figure 2. Observed courier visits to University of Southampton halls of residence by time interval (Saturday 28/11/15 - Friday 4/12/15, 09:00 to 17:00).

The amount of time spent by couriers at the hall reception points was typically quite short, with the mean observed dwell time being between 4 and 6.5 minutes (Figure 3) with no issues associated

with access impacting on dwell time being observed at any of the locations. When looking at the delivery statistics of the most frequently observed carriers, Amazon showed the greatest standard deviation in dwell time, highlighting the time needed to book in large consignments (Table 2). Operating practice was observed to differ between logistics companies with some merely arriving and dropping with no waiting or receipting while others handling larger numbers of packages waited for up to 65 minutes in one instance while packages were individually checked in. A consolidated halls post service would aim to re-locate this receipting activity to the consolidation centre where the halls receipt system would be used so freeing up reception staff for other duties.
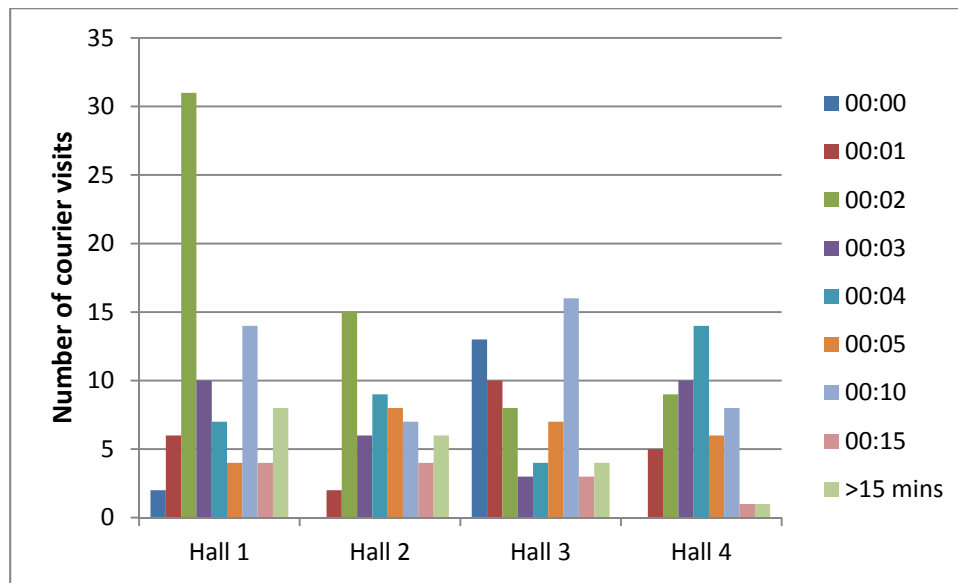
Figure 3. Frequency plot by duration of courier visit (mins) at University of Southampton halls of residenc (Saturday 28/11/15 - Friday 4/12/15, 09:00 to 17:00).

Table 2. Observed activity of the top four logistics providers visiting University of Southampton halls of residence (Saturday 28/11/15 - Friday 4/12/15, 09:00 to 17:00).

Hall (#residents)		Hall 1 (1900)	Hall 2 (1700)	Hall 3 (1100)	Hall 4 (350)
Royal Mail	#packages	659	85	49	41
	#visits	7	6	5	6
	mean dwell time	08:43	11:20	07:12	05:00
	st.dev. dwell time	04:04	05:43	05:24	02:29
Hermes	#packages	209	206	104	37
	#visits	6	5	6	5
	mean dwell time	02:50	10:48	09:20	07:00
	st.dev. dwell time	02:02	05:46	05:10	04:34
Amazon	#packages	247	48	165	47
	#visits	7	6	7	2
	mean dwell time	24:50	15:20	10:24	15:00
	st.dev. dwell time	23:08	12:41	07:37	10:36
DPD	#packages	77	38	50	21
	#visits	7	6	6	7

mean dwell time	05:43	03:10	05:30	03:26
st.dev. dwell time	04:37	01:20	05:53	01:54

4.3   Number and volume of packages delivered

In order to determine how halls post could be consolidated and handled via a consolidation centre, it was necessary to classify the size and type of packages received, and understand how the volumes would vary during peak and off-peak periods. Observations of the package holding areas at each of the halls along with dialogue with the reception staff and halls managers derived a package and bag classification system to be used by the surveyors to categorise individual deliveries as they were received during the activity audit. These were:

Bags

- Small = 320mm x 240mm x 100mm = 0.00768m^3
- Medium = 440 x 320 x150   = 0.02112m^3
- Large = 500 x 420 x 200   = 0.042m^3

Boxes

- Small = 305mm x 305mm x 305mm = 0.028373m^3
- Medium = 406 x406 x 406   = 0.066923m^3
- Large = 510 x 510 x 510   = 0.132651m^3

To support the consolidation cost-benefit analysis, numbers of packages delivered during the survey week were counted and volumes estimated. A total of 3,504 parcels (bags or boxes) were delivered across the four sites during the survey period (Figure 4) with the halls housing the largest numbers of students receiving the most parcels.
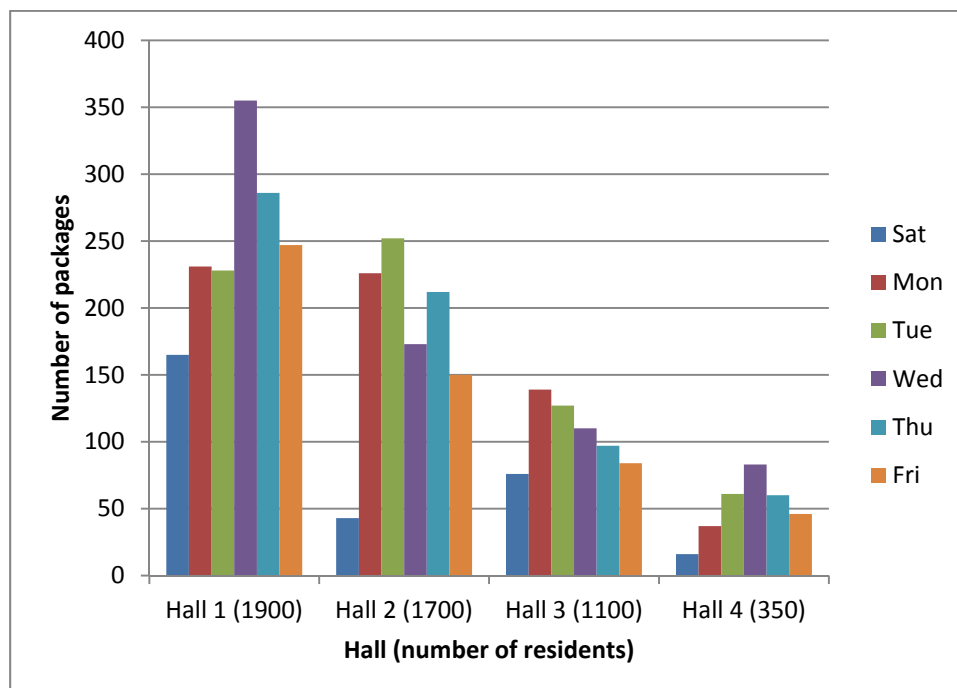
Figure 4 – Numbers of parcels delivered to University of Southampton halls of residence during the survey period (Saturday 28/11/15 - Friday 4/12/15, 09:00 to 17:00).

A breakdown by courier showed that Royal Mail delivered the greatest number of parcels (834, the vast majority of which (659) were to the largest hall), followed by Hermes (556), Amazon (507), DPD (186), Parcelforce (166) and Yodel (118). Dividing the number of packages delivered by the number of visits, for each carrier and for each hall gave some indication of the level of efficiency of each operation. Most efficient, on this basis, was Royal Mail at Hall 1, who delivered an average 94 parcels per visit, with their average across the four halls being 35 parcels per visit. They were followed by Hermes (25 parcels per visit), TNT (24) and Amazon (23); all other carriers averaged fewer than 10 parcels per visit.

4.3.1   Volumes of packages delivered

In order to quantify how the current volumes of packages could be managed via a UCC, the estimated total volume of packages delivered during the survey week was determined for both universities in Southampton (Table 3). This indicated that the University of Southampton generated five times more deliveries, by volume, than Southampton Solent University. Comparison with the annual data (section 4.3.2) indicated that the volumes for the Black Friday week were around 2.2 times greater than the average weekly volume at Southampton Solent University.

Table 3. Volume of packages delivered (m^3) to Southampton University (SU) and Southampton Solent University (SS) halls of residence during the survey period (Saturday 28/11/15 - Friday 4/12/15, 09:00 to 17:00).

Hall	Sat	Mon	Tue	Wed	Thu	Fri	Total
Hall 1(1900)	6.8	10.8	12.5	11.8	11.6	7.6	61.2
Hall 2(1700)	1.7	10.3	9.4	5.4	8.3	6.5	41.6
Hall 3 (1100)	3	7.8	4.3	2.7	2.4	2.7	22.9
Hall 4 (350)	0.7	1.1	2.1	4.4	1.8	1.6	11.7
SU Total	**12.2**	**30**	**28.3**	**24.3**	**24.1**	**18.4**	**137.3**
Hall 1 (208)	0.53	0.68	0.42	0.74	0.68	0.79	3.8
Hall 2 (422)	1.2	1.28	2.0	2.2	1.3	1.3	9.3
Hall 3 (240)	0.55	0.74	0.44	0.92	1.1	0.55	4.3
Hall 4 (228)	0.28	0.36	0.64	0.88	0.84	0.52	3.5
Hall 5 (391)	1.1	1.4	1.3	1.0	0.48	1.3	6.6
SS Total	**3.64**	**4.42**	**4.79**	**5.73**	**4.45**	**4.49**	**27.5**

4.3.2   Seasonal trends in package delivery

The Southampton University halls post audit covered a week's worth of delivery activity following the Black Friday e-retail event. To look at the wider delivery trends across the academic year, data from the package receipt system at Southampton Solent University covering 5 of their halls between 1st September and the 30th June 2016 were used (Figure 5). The data confirmed the observation made by a hall manager that parcel volumes are greatest just after students receive their grant cheques (October, January and just after Easter) with October and January being the busiest months for package receipt, with just over 2,500 parcels per month. Weekly analysis confirmed that the week immediately following the Black Friday sales event received the most deliveries (761 parcels across the five halls, 1,489 residents) with the next busiest being the week commencing 18th January, likely related to January sales and incoming grant cheques. The observed quiet periods corresponded to Christmas, Easter and summer vacations when few students remain in halls.
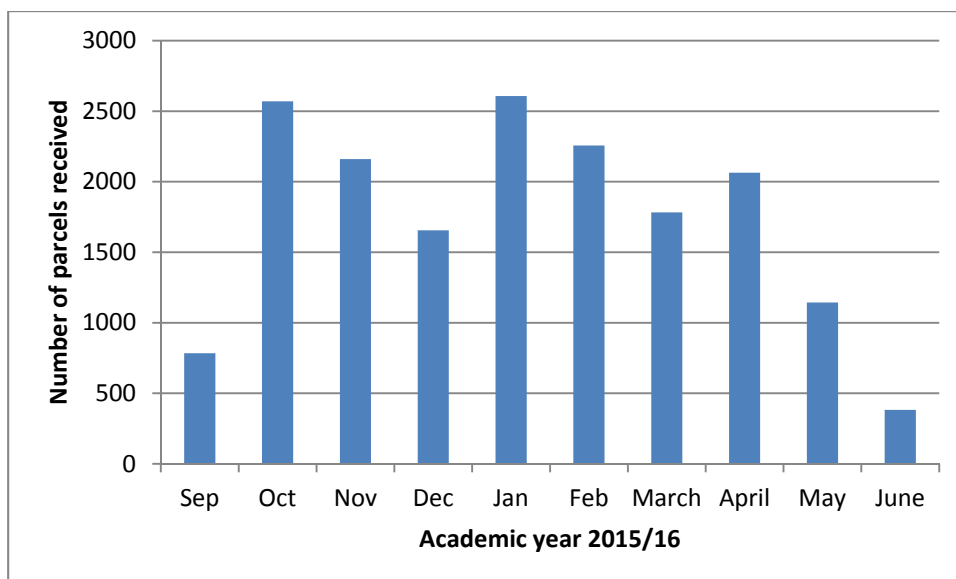
Figure 2. Seasonal trend of parcel volumes received across 5 halls of residence (1,489 residents) at Southampton Solent University (September 2015 to June 2016).

4.4   Package volumes and inferences for UCC adoption

The data collected from the halls delivery audits were extrapolated to consider the annual delivery requirements for all the student halls, including those not surveyed (Table 4). This suggested that the two universities might expect to receive across their 14 student halls complexes (8,886 residents), around 128,000 packages per year, (a mean of 14 packages per student per year). These would be delivered by around 20 different logistics providers across 13,500 visits. The total estimated volume (4,194m^3) equates to 4194 roll cages (a typical roll cage has 1m^3 capacity), or a daily equivalent of 17.5 roll cages, if one assumes a 40-week academic year (mid-September to mid-June) and deliveries six days a week. Depending on the delivery time requirements of the university halls, such volumes could be consolidated onto either a single 18-tonne rigid lorry or onto two smaller vehicles each day rather than the estimated 56 separate vehicles currently experienced.

Table 4. Estimated annual delivery activity to 14 halls of residence serving Southampton and Southampton Solent universities.

	University of Southampton	Southampton Solent University	Total
No. of halls	8	6	14
No. of residents	6592	2294	8886
No. of packages	101601	26822	128423
No. of courier visits	8249	5263	13512
Package volume (m3)	3392	802	4194

4.4.1 How a consolidated halls post system might function

Working with the operator of an existing UCC in Southampton (Meachers Global Logistics (MGL)[1]), a theoretical consolidated halls post system serving the 14 halls of residence across the two universities was devised and would offer the following service:

Redirection of deliveries - Deliveries to student halls would be made via the Southampton Sustainable Distribution Centre (SSDC), located on the Nursling Industrial Estate on the western side of Southampton (Figure 7). Students would be instructed to give their delivery address as 'Hall name, c/o SSDC address' and this would be reinforced by informing the major carriers, including Royal Mail, to redirect all participating hall deliveries via the SSDC.

Receipting – MGL would take receipt of hall deliveries using the same receipting systems as those currently used by the two universities so that staff and students would retain the same visibility and tracking currently experienced.

Sorting – Parcels would be sorted at the SSDC into roll cages or other suitable containment devices for subsequent delivery. The sorting would be arranged to suit the halls with alternative options envisaged (e.g. by student surname and/or by hall block, where requested).

Delivery round – Each hall would receive a single delivery each day from MGL at a time to suit the halls staff and students (Table 11). To reduce the numbers of vehicles required and keep costs to a minimum, a single delivery vehicle would be used where possible, operating on a milk round basis, visiting halls in turn. While it may be possible to cater for specific delivery demands from one or more halls, it would likely not be practical or efficient, if all halls demanded a strict delivery time window, especially if they were similar. The shortest vehicle route around the 14 halls, starting and ending at the SSDC, was estimated to be 32km, with a free-flow travel time, excluding stops or possible traffic delays, of 1 hour 11 minutes, using commercially available vehicle routing software (DPS Route Optimiser[2]), Figure 8. Environmental benefits would be enhanced by the use of an electric vehicle for deliveries, a practical proposition here as the delivery round would be relatively short.

Delivery – Delivered items would be transferred from the roll cages or other containers into the hall's own permanent storage racks/areas. This could either be done by MGL on delivery, or by hall reception staff subsequently, with empty roll cages / containers being picked up by MGL on a subsequent delivery visit. The former option would likely be preferred by halls where there is little or no storage space available. It should be noted that roll cages could not act as a replacement for hall storage racks as they would not be emptied from one day to the next, with observations suggesting that some students could take several days to collect their items.

[1] https://www.meachersglobal.com/
[2] http://www.dps-int.com
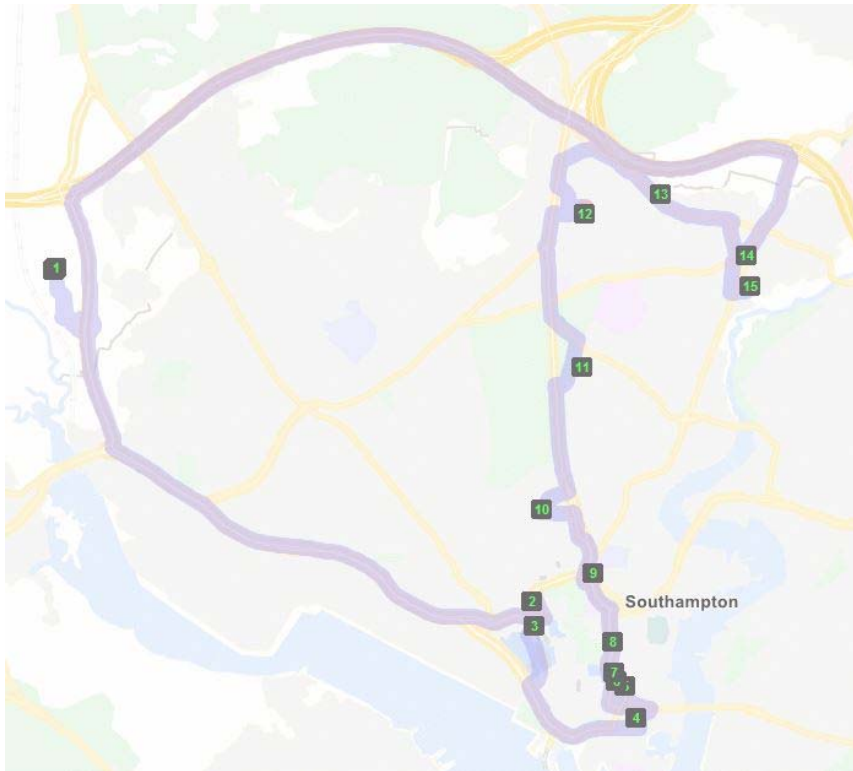
Figure 7. Shortest path route (32km) for servicing university halls across Southampton (2 to 15) from the current Sustainable Distribution Centre (1) operated by Meachers Global Logistics.

4.4.2 Handling special and time dependent deliveries

Of concern with moving to a consolidated halls post concept is how special and timed deliveries should be handled, given that the consignee may have paid a premium to receive the item before a certain time. From a legal perspective, it may be difficult for a HEI to restrict such requests and limit residents to the timings of a managed halls post service. The results from the package receipt audits and student preference data suggested that same-day and next-day before 12pm deliveries could account for 7% and 5% of the deliveries received respectively, and that as a result, approximately 40% of courier visits may continue to be made if these urgent deliveries were excluded from the consolidation scheme. On this basis, consolidation could have the potential to reduce the total number of delivery visits to halls by 35%, from the current 13,512 (Table 4) to 8,765, that is 5,405 direct by couriers with 3,360 consolidated deliveries via the consolidation centre (14 halls x 40 weeks x 6 days/week). In this case, where urgent and timed deliveries were excluded, a single van (e.g. a long wheel based Transit) may be sufficient for use.

4.4.3 Estimating the costs of a consolidated halls post service

The cost of providing the consolidated delivery service would be associated with warehouse staff time for i) receiving and receipting in packages from couriers, ii) consolidating packages into vehicle loads and iii) loading out packages onto vehicles; warehouse storage space for package receipt and consolidation (including goods insurance); drivers time in making the deliveries; and vehicle running costs. To derive an estimate of service cost, the estimated annual package throughputs (Table 4) across all 14 halls covering both universities (8,886 residents) were used, under a theoretical policy that all purchases made by students for home delivery would have to go via the SSDC.

Based on the combined annual delivery volume of 4,194m^3 estimated for both university's halls and assuming the use of a long wheelbase van with a carrying capacity of 14m^3, MGL estimated that their service would equate to an approximate average cost of £17.88 per student per year (Table 5), based on a 40-week academic year (mid-September to mid-June) and 6 day week service (not including Sundays).

Table 5. Estimated consolidated delivery cost based on a combined annual delivery volume of 4194m^3 packages to both universities in Southampton using a long wheelbase van (capacity 14m^3)

Item	Requirement	Daily rate	£ per day	£ per year (40 wks x 6 days/wk)
Driver and vehicle	10 hrs/day	£35/hr	350	84000
Warehouse admin	14 hrs/day	£18/hr	252	60480
Warehouse space	1000 sq.ft	£0.06/sq.ft/ day	60	14400
Total			662	158880
Cost per student (=Total/8886)			0.07	17.88

4.4.4 The implications for halls staff from adopting a consolidated post system

One major advantage of adopting a consolidated halls post service would be the potential time that could be saved by reception staff from receiving a single receipted and pre-sorted delivery rather than having to deal with multiple couriers arriving throughout the day. A senior halls manager undertook a time-and-motion assessment to quantify the amount of time spent by reception staff on specific tasks related to managing student post. The results (Table 6) suggested that the present system could take 210 minutes of receptionist's time per day of which 60 minutes would be spent dealing with couriers, 100 minutes logging parcels into the system and 30 minutes liaising with students to handover items (Table 6). It was estimated that up to 20 minutes per day could be spent retrieving packages delivered to other halls in cases where a reception desk had been unattended when the courier arrived. With the receipting and booking in processes out-sourced to the UCC, it was estimated that a halls receptionist could save in the order of two hours per day which could be re-allocated to other tasks.

Table 6. Estimated time savings for an individual member of reception team per day

	Time spent (minutes)	
	Now	After consolidation
Receiving goods from courier	60	30
Logging parcels onto computer system	100	20
Retrieving parcels delivered to another hall	20	10
Handing parcels over to students	30	30
Total	210 (3.5 hours)	90 (1.5 hours)

5 Results - Student on-line shopping survey

Having established the extent of package delivery to halls of residence as a result of students' on-line purchasing, the next step was to investigate the reasons behind these observations and how students might react to the imposition of a consolidated delivery service.

5.1 Products ordered for home delivery and delivery options chosen

Students ordered a diverse range of products for home delivery (Table 7). Clothing and footwear topped the items purchased online (41% ordered at least once per month) which reflects national market intelligence data (Mintel 2015c) and is in line with European retail experiences where 48% of consumers purchase in this category (Eurobarometer, 2013).

Takeaway meals were also a significant product purchased for delivery to halls (38% ordered at least once per month) and generate substantial small vehicle trips with 40% of meal deliveries in the UK being ordered on-line (Daily Telegraph, 2016) and Deliveroo having over 3,000 registered couriers in London alone (The Guardian, 2016).

Students typically selected standard delivery options for non-food items with 58% stating that 90% of their on-line purchases came via that delivery option. Other options were used, with 14% of the respondents purporting to be regular users of next-day delivery services with 90% of their on-line purchases coming via that route reflecting the growth in this area (Ofcom, 2015). Same-day delivery was rarely used with 86% of respondents stating that they had never used it. This is usually the most expensive delivery option and reflects Ofcom's (2015) finding that 60% of consumers do not want to pay for upgraded services which will be enhanced by the generally restricted budgets of students. Delivery to collection points, such as unattended lockers (90% never used) or convenience stores (86% never used), were also unpopular delivery choices with click-and-collect in-store proving a more commonly chosen alternative with only 56% of respondents stating that they had never used it.

Attitudes to delivery indicated preferences for cheaper options reflecting student budgets, however, next day delivery would be used where items were needed urgently (Table 8).

Table 7. Frequency of products ordered for delivery to students living in University of Southampton halls of residence (n=405).

Statements listed in order of frequency of delivery	Never (%)	Less than once every six months (%)	Once every six months (%)	Once every three months (%)	Once per month (%)	Once per fortnight (%)	Once per week (%)	More than once per week (%)
Clothing and footwear	27	7	7	20	24	13	3	1
Takeaway meals for delivery	37	10	4	12	17	10	9	2
Hard-copy books and/or magazines	34	11	10	17	19	6	2	1
Electrical/electronic goods	36	78	11	16	13	5	2	1
Cosmetics and/or toiletries	57	6	5	12	12	5	2	1
Groceries	67	4	2	5	7	7	7	2
Jewellery and accessories	62	10	6	10	8	4	1	1
Computer hardware and accessories	56	13	10	10	7	2	1	<1
Stationery	61	8	9	10	8	4	<1	<1
Hard-copy music and/or film	72	9	4	7	6	2	1	<1
Health products (vitamins, proteins etc.)	77	5	3	7	5	2	1	0
Toys and/or games	72	9	7	5	5	1	1	<1
software	78	7	5	4	4	2	1	0
Furniture/home furnishings	73	11	7	5	3	1	0	0
DIY	81	8	3	3	4	1	1	<1

Table 8. Attitudes to delivery options by students in University of Southampton halls of residence (n=405)

Statements listed according to decline in agreement (based on combined strongly agree and agree score)	Strongly agree (%)	Agree (%)	Uncertain (%)	Disagree (%)	Strongly disagree (%)
I would choose whichever is the cheapest delivery option	51	34	11	3	1
I only choose next-day delivery when I need an item urgently	46	35	10	6	3
Providing Locker banks around campus would be useful to me	22	35	27	10	7
I would be prepared to wait longer for my goods if it meant the retailer could bundle them together into one delivery	16	37	25	16	6
Wherever possible I choose next day delivery	23	19	21	22	16
Same-day delivery services will be important to me in the future	9	27	31	21	13
I would be prepared to pay extra to have same-day delivery	4	16	22	33	25

During the Black Friday sale week, 42% of the respondents made a purchase with clothing and footwear being the most prominent items purchased (Table 9), reflecting the general prevalence of online shopping for these items (Mintel, 2015c). Of students making purchases during this week, the majority made 1 or 2 purchases (66%), however 16% purchased 4 or more items indicating a group of more frequent online shoppers.

Table 9. Online purchase of products by 177 students in University of Southampton halls of residence during the Black Friday sale week (Saturday 28/11/15 - Friday 4/12/15).

Product	%
Clothing and footwear	28
Electrical goods	14
Cosmetics and toiletries	9
Groceries	7
Takeaway meals	7
Hard-copy books and magazines	7
Jewellery and accessories	7
Health products	5
Computer hardware	5
Stationery	4
Toys and games	4
Furniture/home furnishings	3
Hard copy music/film	2
DIY	2
Software	1

Product purchase habits and delivery options were examined in relation to gender and fee status (home/EU versus international students). The analysis indicated some demographic patterns but effect sizes were small and suggested these factors play a limited role. No evidence was found to suggest that HEIs with all female halls of residence would see significantly different purchasing habits compared to all male halls.

5.2 Investigating the characteristics of frequent shoppers

In order to identify frequent purchasers, the responses in Table 5 were given numeric codes (1 = never purchase this item on-line to 8 = purchase this item more than once per week). This provided a scale that was then summed across the 15 items for each respondent to give a measure of purchase frequency with scores theoretically ranging from 15 (people who never purchase on line (3.2% of sample)) to 120 (people who purchase all items more than once per week (0% of sample)). The respondents were then split into two groups around the mid-point in the data (score of 30 or less = infrequent shopper (47.4%), score of >30 = frequent shopper (52.6%).

Mann-Whitney U tests revealed frequent shoppers were statistically more likely to use a range of more time dependent delivery options and collection points (Table 10) and are therefore likely to be driving the growth in non-standard delivery formats (Ofcom, 2015). This group were more concerned about speed of delivery as they were likely to choose next-day services, more willing to pay for same-day delivery and consider this will be an important consideration for them in the future. Frequent shoppers therefore seek to reduce the delay in product gratification (Park and Kim, 2007) and are therefore less likely to accept the consolidation option, however, though significant effects were found, the effect sizes were small and this pattern is not marked. Frequent shoppers were also more likely to consider locker banks important and less likely to choose the cheapest delivery option. During the Black Friday sales week, frequent shoppers were associated with significantly more on-line purchases ($\chi^2_{(1)}$ = 16.90, $p<.001$) and based on the odds ratio, the odds of purchase during Black Friday week were 2.4 times higher for frequent on-line shoppers.

Table 10. Frequent shopper effects on delivery options. Mann–Whitney test results

	Mean rank Frequent shoppers	Mean rank Not frequent shoppers	U	r
Home delivery options				
Standard delivery during the working day (Packages arrive in the daytime within 5 -63 days)			NS	
Next Day delivery (No time mentioned)	228	172	25,632	.25**
Next Day AM delivery (7:00 – 12:00)	212	184	22,332	.18**
Next Day PM delivery (12:00 – 18:00)	214	183	22,730	.20**
Next Day evening delivery (17:00 – 22:00)	215	181	23.079	.23**
Same-day delivery	210	187	21.870	.16**
Weekend delivery	212	185	22,339	.18**
Delivery to a Collect Point lockerbank	205	192	20,963	.11*
Delivery to a Collect Point convenience store			NS	
Click and collect in-store			NS	
Attitudes towards home delivery options				
Wherever possible I choose next day delivery	224	180	28,879	.19**
I would be prepared to wait longer for my goods if it meant the retailer could bundle them together into one delivery			NS	
I would be prepared to pay extra to have same-day delivery	219	185	23,816	.15**
Same-day delivery services will be important to me in the future	218	185	23,643	.14**
Providing Locker banks around campus would be useful to me			NS	
I would choose whichever is the cheapest delivery option			NS	
I only choose next-day delivery when I need an item urgently			NS	

U is Mann–Whitney's U statistic, r is the effect size estimate
*Significant at $p<.05$
**Significant at $p<.01$
NS is not significant

5.3   Attitudes towards a consolidated delivery service via a UCC

The consolidated delivery concept was positively received by students as 84% were generally 'not too bothered how parcels arrive' (Table 11). The students also stated that they had reasonable levels of trust that the university had the competence to deliver the service but 81% expressed concern about who would be responsible for loss or damage to packages, making performance risk (Shin et al., 2016) a potential barrier.

Students were understandably cost sensitive reflecting general consumer views that free delivery is important (Ofcom 2015). Related to this, speed is less of a barrier which is encouraging for the

consolidated delivery model as consumers would potentially experience some delay in product gratification (Park and Kim, 2007). Consolidated delivery would provide students with a time window in which they would expect to receive deliveries which, given that consumers like delivery notification and tracking (Ofcom 2015), would be an added benefit. Open ended comments indicate students often experience some delay in parcel receipt even when the parcel has arrived at the hall due to notification and handling problems, consolidation would mitigate this.

There were some small effects related to gender and fee status, however, no strong evidence of marked differences based on demographic characteristics. The frequent purchase group were more likely to get 'swept up in the excitement of the moment' (Zimbado 1999) (frequent purchase mean rank = 219, non-frequent purchase mean rank = 184, U = 23,958, $p<$ .01, r = .16) and more likely to choose the fastest delivery option regardless of cost (frequent purchase mean rank = 221, non-frequent purchase mean rank = 181, U = 24,197, $p <$.001, r = .18). These are both time critical issues, the latter being a barrier to the proposed solution since some of the faster delivery options will be compromised by routing through the centralised distribution centre, however, effect sizes were small.

The attitudes of respondents towards consolidated delivery were explored further using cluster analysis to identify groups. Ward's method was used, which minimizes within-group variation (Hair et al., 2010), and a squared Euclidean distance measure. Two outliers were removed during analysis and a three cluster solution emerged that was conceptually most useful (Table 12).

Cluster 1 (n= 183) – Contented and speed ambivalent – this cluster is happy with the status quo and trust their University to handle goods. Speed of delivery is not an issue.

Cluster 2 (n=64) – Speed concerned sceptics – lack trust in their University's ability to handle goods and are unhappy about current deliveries procedures. Speed is an issue. Same day delivery is reasonably important.

Cluster 3 (n=150) – Contented but speed, risk and cost concerned – trust their University to handle goods, but concerned about responsibility for damage/loss, get swept up in the moment, and more likely to choose fast delivery options.

Table 11. Attitudes towards consolidated delivery by students in University of Southampton halls of residence (n=405)
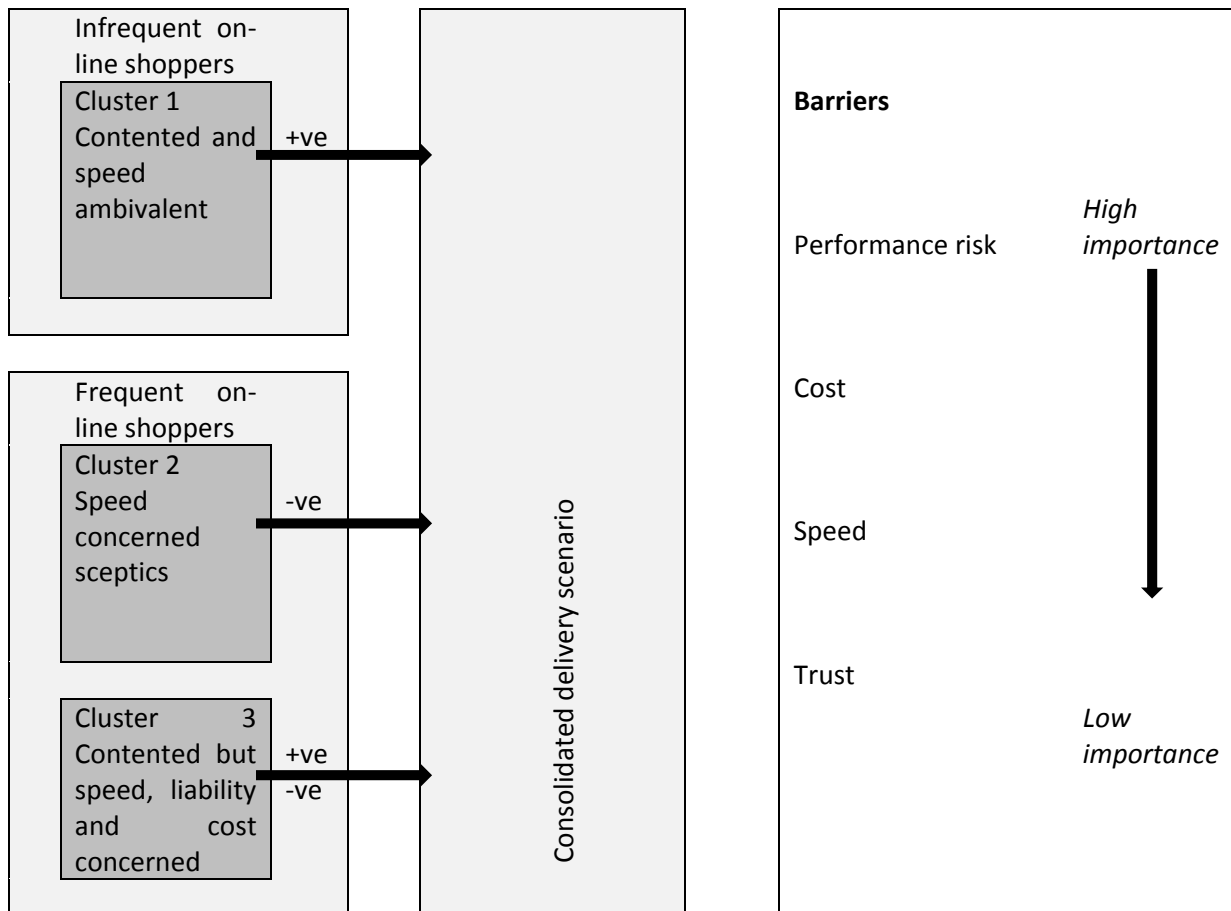
Statements listed according to decline in agreement (based on combined strongly agree and agree score)	Strongly agree (%)	Agree (%)	Uncertain (%)	Disagree (%)	Strongly disagree (%)
As long as my parcels arrive for me to collect at halls reception at some point during the delivery day, I'm not too bothered how they arrive *(general acceptance statement)*	44	40	11	5	2
I am concerned about who would be responsible if my packages were lost or damaged *(performance risk)*	42	39	14	5	1
I would prefer a standard delivery with the lowest cost *(speed and cost)*	42	37	18	3	1
I am satisfied with the current way my parcels are managed by my hall of residence *(current satisfaction)*	35	42	17	5	1
I think that the University has sufficient experience in handling goods to carry out this delivery service *(trust)*	19	53	19	7	2
I think that the University knows its students well enough to offer them a delivery service adapted to their needs *(trust)*	16	49	25	7	3
Reducing our carbon footprint is important to me and consolidating deliveries in this way could help that *(climate change)*	25	44	25	4	3
I would be more willing to have my delivery made to a collection point if I could get my package quicker *(speed)*	21	30	31	15	4
When shopping on-line I find myself getting swept up in the excitement of the moment and want the delivery as quickly as possible *(speed)*	15	26	25	25	10
Same-day delivery is important to me and the service would need to be able to provide that *(speed)*	11	21	38	24	7
I will always choose the fastest delivery option regardless of the cost *(speed and cost)*	3	4	13	35	46

Table 12. Impact of cluster membership on consolidated delivery

	Cluster	Mean rank*	Kruskal-Wallis test
As long as my parcels arrive for me to collect at halls reception at some point during the delivery day, I'm not too bothered how they arrive (general acceptance statement)	1 2 3	220 117 209	H(2) = 47.27 *p*< .001
I am concerned about who would be responsible if my packages were lost or damaged (responsibility)	1 2 3	161 223 235	H(2) = 42.80 *p*< .001
I would prefer a standard delivery with the lowest cost (speed and cost)	1 2 3	213 152 202	H(2) = 15.84 *p*< .001
I am satisfied with the current way my parcels are managed by my hall of residence (current satisfaction)	1 2 3	218 87 224	H(2) = 83.11 *p*< .001
I think that the University has sufficient experience in handling goods to carry out this delivery service (trust)	1 2 3	206 104 231	H(2) = 67.02 *p*< .001
I think that the University knows its students well enough to offer them a delivery service adapted to their needs (trust)	1 2 3	212 103 224	H(2) = 63.70 *P*< .001
Reducing our carbon footprint is important to me and consolidating deliveries in this way could help that (climate change)	1 2 3	217 114 213	H(2) = 47.72 p< .001
I would be more willing to have my delivery made to a collection point if I could get my package quicker (speed)	1 2 3	183 235 203	H(2) = 10.93 p< .01
When shopping on-line I find myself getting swept up in the excitement of the moment and want the delivery as quickly as possible (speed)	1 2 3	112 225 295	H(2) = 225.34 p< .001
Same-day delivery is important to me and the service would need to be able to provide that (speed)	1 2 3	140 247 251	H(2) = 97.94 p< .001
I will always choose the fastest delivery option regardless of the cost (speed and cost)	1 2 3	156 235 236	H(2) = 55.16 p< .001

*A higher mean rank indicates stronger agreement

Clusters 2 and 3 were associated with frequent shoppers ($\chi^2_{(2)}$ = 11.452, p <.003). While cluster 1 indicated acceptance of the scenario, this group shopped online less and it is therefore the attitudes of clusters 2 and 3 which will most influence success of a consolidated delivery initiative. Cluster 2 demonstrated least acceptance of the scenario which reflects a degree of unhappiness with existing procedures and concerns about delivery speed. Cluster 3, on the other hand, indicated acceptance of the scenario with some reservations. Therefore while overall, the picture is quite positive for acceptance, there is evidence of a resistant group and potential barriers that would need to be overcome (Figure 7).

Infrequent on-line shoppers			
Cluster 1 Contented and speed ambivalent	+ve		

Frequent on-line shoppers			
Cluster 2 Speed concerned sceptics	-ve		
Cluster 3 Contented but speed, liability and cost concerned	+ve -ve		

Consolidated delivery scenario

Barriers

Performance risk   *High importance*

Cost

Speed

Trust

Low importance

Figure 7. Attitudinal barriers to a proposed consolidated delivery scenario

5.4   Preferred collection times and inferences for consolidated deliveries

Any consolidated delivery service would need to establish the most convenient delivery time with each hall as part of a milk round type service. The survey suggested that the most favoured time was between 17:00 and 19:00, with the next most favoured either side of this (Table 13) and it was concluded that a service supplying halls with parcels in the late afternoon would be acceptable to residents.

Table 13. Preferred parcel collection times of students in University of Southampton halls of residence (n=405)

Time of day	Average rank (1st to 6th)
07:00-09:00	4.99
09:00-12:00	4.27
12:00-14:00	3.76
14:00-17:00	2.88
17:00-19:00	2.11
19:00-23:00	2.93

6 Discussion and conclusion

Urban Consolidation Centres (UCCs) with the capacity to consolidate parcel deliveries for urban locations present a good opportunity to address externalities arising from online retail. The potential of this opportunity depends on the key stakeholders who supply and deliver products and the end consumers. This paper has presented an analysis of a theoretical consolidated parcel delivery service for student halls of residence using historic parcel receipt records for 14 halls in Southampton, UK. It has analysed the scale of the parcel delivery problem, the student purchasing traits generating the activity and identified the extent to which this could be addressed by a parcel consolidation solution. It has also addressed the limited analysis of consumer views of delivery choices and provides an initial evidence base.

With over 385,000 students living in halls of residence at UK HEIs (Higher Education Statistics Agency, 2015) and with many UK cities having purpose built complexes housing over 8,000 residents, this research suggests that in such instances, over 13,000 courier trips could be generated annually to such complexes as a result of students' on-line purchasing behaviours. With the drive to make HEIs more efficient and reduce their environmental impact (People and Planet, 2015; Universities UK Efficiency and Modernisation Task Group, 2011), addressing the secondary effects of their students' activities as opposed to facilities might be one way to help achieve this. There is therefore a strong organisational imperative to act. Reducing the transport footprint to halls of residence could not only benefit a HEI but the local authority and residents who would potentially gain from reduced vehicle activity, reduced parking infringements, improved air quality and journey times in the surrounding urban area. The analysis of courier activity to 14 halls in Southampton suggested that courier vehicle visits could be reduced from 56 per day to 1 using consolidated deliveries. Additional benefits gained by HEI halls' staff due to a much reduced level of interruption to day-to-day operations would add to the cost-benefits of implementing the service.

Consolidated parcel delivery is likely to be accepted by students, however, there are caveats. This study reinforces the evidence that young people are active in online retail with clothing/footwear and takeaway food leading the items purchased (Mintel, 2015c; Eurobarometer, 2013). While the latter presents no opportunity for consolidation, clothing represents a relatively low cost, non-urgent product which is suited to consolidated delivery.

The student consumers were most concerned about 'performance risk', a transaction concern regarding responsibility for loss or damage to packages (Shin et al., 2016). This is, however, likely to be over emphasised as an artefact of survey design since few people would be unconcerned about loss or damage to items. Analysis indicated numerous relatively low-value purchases were delivered during Black Friday week. As performance risk increases with item value (Sinha and Singh, 2014), this concern is likely to be marginal for most items, especially clothing and footwear which are commonly purchased. The number of online purchases made by students supports Chapparo-Peláez et al., (2016) who found delivery risk was not a significant barrier in online retail. However, the addition of an UCC adds to the supply chain and potential opportunities for loss or damage to items. A consolidation solution will therefore need to address which organisation covers the cost of missing or damaged goods.

Additional costs derived from consolidation would also be a concern for student consumers reflecting the general population's desire for free delivery (Ofcom, 2015). In this research, a consolidated halls post service via a UCC serving 14 halls of residence (8,886 residents) generating an estimated $4,194m^3$ of packages per annum over a 40-week academic year was estimated to cost £17.88 per student per year. Consideration therefore needs to be given to funding the initiative raising questions of how to allocate costs relative to the benefits of a UCC scheme (Allen et al., 2012). Much will therefore depend on how the benefits are perceived relative to the costs by universities and local authorities involved. Costs could be recovered from students through hall of residence fees and hidden from these end users, though there are arguable ethical issues here, since students will make differential use of the service. Some costs might also be apportioned to carriers who benefit from time savings through avoiding deliveries to congested urban areas (Allen et al., 2012), however, this benefit is minimal where carriers will continue to make other deliveries in these areas.

Speed of delivery is important to online purchase decisions (Ofcom, 2015; Park and Kim, 2007) but this research and the wider body of knowledge suggests that shoppers, and particularly cost conscious students are not prepared to pay for upgraded and faster delivery services (Ofcom, 2015). This is advantageous from the perspective of a consolidated halls post service via a UCC which would struggle to meet same-day or early morning next-day deliveries due to the time required for the consolidation element which necessarily introduces some inherent delay. For non-urgent items, likely to be the majority of cases, the delay is unlikely to be important given the student attitudes revealed in the online survey (e.g. positive response to waiting for bundle items) and in the observation that some items can sit in hall receptions for several days before being collected by a student. However, some students will want text books or other items urgently for legitimate reasons, and it is questionable whether the student should, or could, be denied access to premium delivery services.

At the same time, increasing numbers of carriers are moving towards next-day delivery as standard at no extra cost, further shifting consumer delivery expectation norms. The UCC operator would have to implement a cut-off time for receiving goods in order to guarantee delivery on the same day as they were received from the couriers. For more frequent on-line shoppers, this might pose a problem if a retailer was offering a guaranteed next-day delivery for orders placed by 22:00 and the UCCs cut off time for consolidation was 21:00. In this circumstance, the student would not receive their package until two days after the order was placed which contravenes the 'next-day' guarantee given by the retailer.

Analysis indicates frequent shoppers seek to reduce the delay in product gratification (Park and Kim, 2007) and a proportion could reject the consolidation option if it did not meet their delivery requirements for specific products. However, though significant effects were found for frequent shoppers related to more rapid delivery options, the effect sizes were small. This issue would be highlighted further where retailers offering online order tracking inform the consignee that the delivery has been made when it is in fact only to the UCC and not, as the student may believe, to their hall reception. To counter this, it might be possible to exclude premium delivery items from the consolidation service but this could undo many of the transport-related benefits if significant numbers of couriers continue to visit the halls, which this research suggest could be up to 40%.

Related to the temporal dimension of speed is the transparency of deliveries. A consolidated delivery late-afternoon would be most acceptable to students and has the advantage that students would know when to expect parcels to arrive, an improvement on the existing service. There are also time-saving benefits for couriers from having a single drop location (the UCC) instead of deliveries to several different halls across an urban area.

Potential challenges that would have to be considered include enforcement of the new delivery address making good communication with students and couriers essential. Such a scheme would ideally commence at the start of a university year, with all incoming hall residents being informed of the new delivery address, the rationale and their contractual responsibilities as halls residents. It would also be essential to instruct the main couriers about the required redirections to avoid them trying to deliver direct to halls rather than via the UCC. Previous research indicates that UCCs are successful only if the imposing organization is able to control or strongly influence all the potential carriers and receivers of goods (Allen et al., 2012). This has previously been achieved in the case of construction project UCCs and UCCs that serve large sites with a single landlord. In this instance, though Universities have an opportunity to communicate with students, the reality is they have little control over which address students use. The carriers involved will also be serving other addresses in the area and may have little incentive to divert parcels to the UCC. Space at halls is also a challenge and is likely to impact on the transfer strategy. There are also operational issues to address such as the courier requirement for the recipient's signature and undeliverable items, for example, where the student no longer resides at the hall.

6.1   Further work

The analysis presented in this paper is based on an understanding of existing parcel delivery practices and views of a proposed consolidated parcel delivery solution. Further research is therefore needed to test the initiative through a pilot of parcel consolidation to student halls. While the analysis in this paper is contextual to a specific accommodation and organisational context, the findings offer insight to other urban contexts. There are direct parallels with other forms of large serviced accommodation blocks with implications for the design of new buildings to facilitate delivery and storage. Indirectly, knowledge can also be transferred to non-serviced accommodation blocks and densely populated urban areas in the effort to address environmental externalities. For example, a consolidated delivery services would provide end consumers with better knowledge of when parcels might arrive if a regular known route was used. This would reduce the incidence of parcel delivery failure in comparison to the current dominance of relatively open ended delivery times. Given the university specific context of this study further work is needed in other domains to explore consumer views of consolidation, scope for consolidation implementation and its potential to address existing delivery problems and environmental externalities.

The home delivery sector has evolved in a neoliberal political climate with little external regulation. The highly competitive industry that has resulted embeds much inefficiency. While there are economic imperatives to address this at a company level, there is little incentive to rationalise deliveries with other couriers. The growing recognition of environmental externalities associated with home delivery will increasingly pose problems for retailers as well as couriers. Further research therefore needs to better understand the industry perspective, the scope for new practices and their capacity and willingness to take action.

7   Acknowledgements

8   References

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