Urban Freight in Dublin City Centre: Survey Analysis and Strategy Evaluation

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ABSTRACT

This paper presents the findings from a study evaluating sustainable freight distribution in Dublin City Centre with a particular focus on Urban Distribution Centres (UDCs) and managing the last mile of deliveries. A survey of city centre organisations is described and relevant delivery patterns (origins, destination, types of goods delivered) are compared to those contained in a previous feasibility analysis in order to ascertain UDC opportunities in Dublin. A real-life commercial example of a UDC is also described. Ireland's largest grocery distributor operates this UDC. The operational efficiencies and the wider benefits of the UDC are described in the paper. In addition, a commercial example of managing the last mile of deliveries through a city centre delivery platform is detailed. The delivery platform is managed by a leading logistics service provider.

INTRODUCTION

The purpose of this paper is to document some of the main findings of a freight distribution study in Dublin City Centre. The motivation behind the study lies in a desire to provide a long-term sustainable solution for freight deliveries in the city.

The paper outlines the results of a survey of deliveries to organisations in Dublin City Centre and discusses the suitability of Urban Distribution Centres (UDCs) as a delivery management policy for the city. The results of the delivery survey will be compared with results from a previous feasibility survey (1) in order to identify similar trends in delivery patterns. Of particular interest are the origins of the deliveries and the types of goods transported. This information may help to identify locations for possible UDCs and also clarify the type of goods that may be suited to the centres.

The focus on UDCs as a possible strategy for managing deliveries is largely due to the continued interest in the UDC concept over the past number of years. This may be attributed to a number of factors (2):

1. Awareness on behalf of local planners and policy makers that innovative and perhaps radical solutions to freight distribution are needed to cope with chronic city centre congestion
2. Established transport and distribution operators striving to obtain competitive advantage through new and improved freight consolidation and urban delivery operations
3. Heightened awareness of the environmental problems linked to road freight transport resulting in pedestrianisation schemes, time bans on deliveries and weight restrictions on lorries in towns and cities, all of which support the case for trans-shipment before final delivery
4. The increased popularity of co-operation and partnerships along the supply chain, for example between retailers and major contract distribution companies.

This paper commences with a description of the survey of deliveries to Dublin City Centre. Findings from the survey are described along with a description of a planned distribution centre by Ireland's largest grocery distributor. Finally, a case study of a delivery platform in the city centre dealing with parcel and post deliveries is provided.

DUBLIN CITY CENTRE DELIVERY SURVEY

The survey of businesses in the city centre is the follow-up data collection exercise to the pilot survey described in (1) and forms the primary source of freight related data for the freight distribution study. In order to maximise survey response, it was decided to request businesses to complete a delivery diary for a typical delivery day. The delivery diary can be viewed in Figure 1.

As a starting point, members of a trade association, the Dublin City Centre Business Association (DCCBA) were surveyed. The DCCBA represents a number of business sectors including property, finance, catering, tourism, retail and other general service businesses. Members of the DCCBA constitute the major commercial interests in Dublin City Centre. 175 DCCBA members received survey diaries and in total 21 survey forms were returned. Therefore an initial response rate of 12% was achieved. With membership of over 700, many of which are located in the city centre, the Licensed Vintners' Association (LVA) provided an opportunity to survey the delivery patterns of bars in Dublin City Centre. For the purpose of the survey 73 survey forms were posted out to LVA members (approximately 10% of total

membership). 16 responses were received from LVA members amounting to a response rate of almost 22%. Two further postal surveys of additional trade associations produced an aggregated response rate of 10%. In the light of the response rates to the postal surveys, it was decided to personally distribute survey forms to businesses on predetermined streets. These streets constitute the primary shopping streets in Dublin City Centre and include: Dawson Street, Nassau Street, Suffolk Street, Dame Street, Kildare Street, Westmoreland Street, Aston Quay, Ormond Quay, Middle/Lower Abbey Street and Henry Street

This survey approach was useful from the perspective that helpful feedback and comments made by personnel in the shops surveyed were noted along with the data that was collected. Comments made related to companies' reactions to restrictions in place for delivery times. Also, a number of comments focused on the number of loading bays available close to the premises. Numerous businesses pointed to the fact that deliveries are often forced to park on street because loading bays are often illegally occupied. In total the survey captured 906 individual deliveries. Businesses were categorised into 12 distinct categories. The breakdown of the number of deliveries to each category can be seen in Table 1.

Survey Results

With regard to the nature of delivery vehicle usage, it was found that vans were the most prevalent type of vehicle used, accounting for approximately 55% of all deliveries. Trucks accounted for 40% of the total, while cars and motorcycles only accounted for 6%. The number of trucks captured in the survey (354 in total) is a cause for concern from an accessibility perspective and also from an environmental viewpoint. It highlights the need for more novel delivery solutions for Dublin to minimise the effects of large vehicles on the streets of the city. The average number of miles travelled from supplier to business destination was calculated as 13.65. However, this varied from business to business, for example the average distance for deliveries to pharmaceutical businesses, restaurants and bars was 10.39, 18.45 and 9.39 respectively. The average dwell time for deliveries was 14 minutes while in the pilot survey the average dwell time was 23 minutes.

Frequency of deliveries is analysed firstly according to time of day. Figure 2 shows the number of deliveries arriving each hour. The busiest period for deliveries occurs between 9am and 12pm. The number of deliveries peaks between 10-11am with 16% of the total arriving during this time. Only 2% of deliveries occurred between 5pm and 11pm. Frequency of deliveries was also analysed according to geographical area. Delivery origin locations were categorised according to the Dublin Transportation Office (DTO) coarse zone transport modelling system, which contains 21 zones, as shown in Figure 3. Table 2 shows that the top six delivery generating areas are the south west of the city (zone 6), the city centre (zone 1), outside of Ireland, south Dublin (zone 12), the north west of the city (zone 4) and outside of the Greater Dublin Area (GDA) (GDA includes the counties of Dublin, Kildare, Louth, Meath and Wicklow). For the purposes of comparison, it is useful to note that in the pilot feasibility survey, the top six delivery generating zones were Zone 1, Zone 6, Zone 12 and Zone 14. Therefore Zones 1, 6 and 12 are common to both the pilot survey and the overall business survey indicating a strong level of origin generation in these areas.

Having analysed the frequency of deliveries from zones, the next step in the survey analysis was to examine whether certain categories of goods could be linked to certain zones. Table 3 shows the proportion of goods originating in the six high delivery-generating zones.

Although food/beverages feature strongly in all of the zones, there are a number of instances of other goods categories that are prominent in particular zones. These include:

- Alcohol in zones 1, 6 and 21
- Pharmaceuticals/Cosmetics in zone 12
- Stationary/Books/Newspapers in all six zones
- Household/Hardware Goods in zone 21 and outside Ireland
- Clothing/Shoes in zone 21 and outside Ireland

In terms of the packaging used for deliveries, boxes were found to be the most common type used (53%). In approximately 10% of cases, no packaging was used and the goods were delivered loose. Pallets were used in a further 10% of cases, while parcels, kegs and cartons accounted for 7% 6% and 6% respectively. Various other forms of packaging were used in the remainder of deliveries. Earlier analysis of the packaging used in the pilot survey indicated a correlation coefficient of –0.126 between the type of packaging and the type of goods. This coefficient indicated a very weak relationship between the two variables. When the same correlation exercise was carried out for the overall survey (again using Pearson's Correlation Coefficient as a measurement), a correlation coefficient of 0.224 was obtained. Although still a relatively low figure, it points to a very mild relationship between the variables. The coefficient of determination (COD) is an indication of how far variation in one variable is accounted for by the other variable. In the case of the overall survey, a coefficient of determination of 5% was obtained. In the pilot survey the COD was only 1.5%. The relevancy of the packaging used to UDCs lies in the consolidation opportunities in the UDC itself and the vehicles used to transport the goods from the centre to the city centre. Materials handling techniques such as shrink-wrapping and palletization have the potential to improve delivery operations because goods can be consolidated into larger shipping units (3).

In order to establish if deliveries to certain types of businesses occur at particular times, another correlation exercise was carried out examining the relationship between delivery arrival times and categories of business. It was found that only a very low correlation of 0.104 exists between the two variables. This suggests that at best, only a mild relationship exists between the arrival time of delivery vehicles and the type of businesses that they deliver to at that particular time. In other words, in general the category of business concerned does not appear to dictate the arrival times of deliveries to any significant extent. However upon further analysis of the relationships between arrival time and business category for various streets, some interesting findings were noted. Firstly, a reasonable correlation of 0.335 was found between arrival time and business categories for deliveries to Ormond Quay, Wellington Quay, Bachelor's Walk and Aston Quay (all located along the quays of Dublin's main River, the Liffey in the city centre). Secondly, on the south of the city (Dame Street, Nassau Street, Dawson Street and Kildare Street) a correlation of 0.280 was found. These findings suggest that correlations are more likely to be found at a localised street level than throughout the city centre. This highlights the variable nature of delivery patterns to Dublin City Centre. It also emphasises the influence that the location of a business on a particular street can have on delivery times. This is something that is reinforced by anecdotal evidence from discussions with suppliers. One particular food and groceries supplier highlighted the fact that certain delivery runs were determined to a large extent by the timing of city centre deliveries, which occurred at a particular time of the day.

Another area of interest for statistical evaluation is the relationship between the delivery arrival time and category of good delivered. A correlation figure of 0.249 was

found to exist between the two variables. This mild correlation may help to explain to a certain extent peak delivery hours for certain type of goods. The greatest proportion of food deliveries (over 19%) arrived between 7:00 and 8:00. Furthermore, the greatest proportion of post and parcel arrived between 10:00 and 11:00 and between 11:00 and 12:00 (17% in each case). Peak delivery hour for household goods/hardware occurred between 11:00 and 12:00 when 17% of the total of goods for the category arrived.

Loading arrangements for deliveries formed a further area of interest during the evaluation. 49% of deliveries used on-street parking for unloading goods. Dedicated loading bays (loading facilities operated by the company receiving the delivery) were used for 39% of deliveries, while shared loading bays (loading facilities designated by the city authorities) were used for the remaining 12% of cases. It was observed that 39% of trucks parked on street for deliveries. This has implications for city centre accessibility.

URBAN DISTRIBUTION CENTRE CASE STUDY

The examination of a specific case study of a planned distribution centre for food related products is carried out for a number of reasons. Firstly, results from the overall business survey identified the food/beverages category as one which features prominently among general city centre deliveries. This category accounted for almost 38% of deliveries captured in the survey. This is attributable to the fact that food/beverages are delivered to a broad range of businesses- bars, newsagents, supermarkets, convenience stores, offices and other retail stores. Deliveries to newsagents, convenience stores and supermarkets total 28% of all food/beverage deliveries. Furthermore, it was found that 38% of food related deliveries to the city centre were made using trucks of some description. Therefore, a need existed to explore more efficient means of managing food deliveries to the city centre. Use of a distribution centre located on the perimeter of Dublin was one option that merited consideration.

In November 2003 Ireland's largest grocery distributor announced investment in a new warehousing and distribution centre in Kilcock, which is situated approximately 26 miles from Dublin. Given the importance of food related deliveries to the city centre, a case study of the new distribution centre provided a valuable opportunity to examine in detail the operational issues relating to setting up and operating a distribution centre. The commercial nature of the distribution centre is important because it is hoped that its operation may offer a template, both to other similar private initiatives and indeed possibly to local authorities who may consider operating distribution centres as a means of managing city centre deliveries. This in effect was the second reason for selecting a real-life example of a distribution centre.

A third reason for selecting the new distribution centre as a case study was the fact that with 24% of the grocery market share in the Republic of Ireland, the company is in a strong position to bring about wide-reaching changes to their distribution system that are acceptable from a commercial perspective while simultaneously mitigating against some of the negative impacts that their deliveries may have on traffic and the environment in general.

The company is one of the largest privately owned companies in Ireland. In 2002 Group sales totalled in excess of €2.7 billion. It is estimated that sales have grown by 16% annually over the past five years and pre-tax profits have also grown strongly over the same period. Over 30,000 people are employed either directly by the company or indirectly through retail franchisees. It is expected that the new distribution centre at Kilcock will commence operations in January 2005 and should be fully operational by June of the same

year. The new warehousing and distribution facility is being developed on a 21-acre site at a cost of €35 million. The distribution centre investment forms part of the €70 million capital investment in overall logistics infrastructure and information technology. The centre will comprise 150,000 square feet of warehousing, loading bays, offices, catering facilities and other facilities.

The motivation for establishing a new distribution centre in Kilcock was prompted by a number of key issues. Firstly, as mentioned previously sustained growth and expansion in the market have placed existing logistics infrastructure under increasing pressure. Distribution capabilities are currently operating at their maximum. Stock outs of particular goods are possible in the light of these conditions. Over a prolonged period of time, this may result in compromised customer service, something the company are keen to avoid. The distribution centre in Kilcock therefore forms an important part of the company's overall growth strategy. A second reason for the development of the centre lies in the fact that it will serve to enhance the company's control over the supply chain. Again this relates to the service provided to retailers in terms of the on-shelf availability of products. Thirdly, the company is actively seeking to increase its representation in the Dublin Area and this is something that impacted on the choice of the location of the distribution centre. Kilcock is a location that is accessible to the company's franchise stores both in Dublin and its hinterland area. Figure 4 displays the new M4 motorway, which is close to Kilcock. Regional roads (R125, R407, R148 and R158) also traverse Kilcock and contribute to the good road network of the area.

In order to quantify the benefits of the Kilcock operation on stores located in Dublin city centre, a comparison was made (using 16 city centre stores) between current delivery operations and future deliveries once the distribution centre is in operation. Key areas of interest included:

- Delivery frequency per week
- Average volume delivered (in cases)
- Distance involved in deliveries (in miles)

It was discovered that deliveries to the 16 stores are expected to increase from 17 to 60. This represents an increase of approximately 253% in delivery frequency. However this is considerably offset by the fact that the company removes the need for 17 suppliers to deliver direct to these stores. Therefore 544 (16 stores X 17 suppliers X 2 times a week) individual deliveries are eliminated from the supply chain through using the Kilcock distribution centre representing a net benefit of a reduction of 501 deliveries to the city centre. It is anticipated that the Kilcock operation will allow suppliers to deliver full loads to the centre where they will then be consolidated with products from other suppliers to ensure that the company delivers full loads. It is expected that the average volume for all sixteen shops will increase by 80% (from 4775 to 8617). On average the number of cases delivered to each store by the company will increase by 90%.

Another important benefit associated with the Kilcock Distribution Centre is that it will further assist in the process of "backhauling", which is currently a priority for the company as part of a policy of reducing the environmental impact of the company's transport fleet. Backhauling involves the use of company trucks, which have been emptied after deliveries to collect goods from suppliers on the return trips to the distribution centre. This process helps to eliminate replica journeys by the company's suppliers when dispatching goods to the warehouse. The effectiveness of backhauling is enhanced by high levels of co-

ordination that the distribution centre will provide through its comprehensive logistics system. Currently, (without the distribution centre) it is estimated that backhauling saves around 3,125,000 miles of transport each year. Ultimately the practice of backhauling increases the efficiency of a company's transport fleet. It results in fewer trucks on the road and consequently fewer emissions.

From the point of view of retailers in Dublin, deliveries via Kilcock are beneficial from an administrative perspective and from a customer service perspective. Dealing with one company for a range of products on a single order eliminates a great deal of paper work, which is time consuming and cumbersome. Furthermore, it is hoped that the system will reduce the possibility of stock outs and help increase the range of goods retails keep at their stores.

From the data, potential for replicating an initiative similar to the Kilcock Distribution Centre exists in high delivery generating zones such as Zone 6 (South West of the city) and Zone 12 (South Dublin). Table 3 illustrates that 46% and 47% of the goods originating from zones 6 and 12 respectively are food related. There is a clear concentration of industrial estates in South West Dublin and this is reflected in the survey results. Young, Richie and Ogden (4) found that the four main influences affecting the location of freight facilities were:

- Proximity to arterial roads, freeways and services
- Proximity to customers and other facilities operated by the same firm
- Site availability
- Labour availability

Of these factors, the first was found to be most influential. A UDC located in South West Dublin would benefit from proximity to Dublin's C-Ring Motorway, the M50, along with a number of national roads facilitating good access to customers.

Incorporating food related goods as part of the operation of a municipal UDC can be seen in the case of the city of La Rochelle in France. Here, deliveries to cafés, hotels and restaurants comprised 17% of the total of deliveries made through the delivery platform (5). In addition to catering for deliveries, the distribution centre in La Rochelle also offers storage for staggered deliveries to shop owners. This flexibility, in terms of delivery times is an additional benefit of the UDC and is an important issue for the City of Dublin given Dublin City Council's recent inclusion of restricting Heavy Goods Vehicles (HGVs) in parts of the city at certain times as an option that merited assessment as part of a HGV management strategy (6).

Since a UDC will facilitate more flexible delivery times, night deliveries are more likely to occur, especially in light of future possible restrictions on delivery time windows. However, it is important to acknowledge that deliveries that take place at night are likely to produce noise disturbance and this is a major concern for local authorities, national governments, the EU Commission, businesses and local communities. Therefore, it is important to examine (when evaluating a UDC), the best way to minimise noise nuisance of night deliveries. The Peak Programme in the Netherlands (7) examined a range of technical modifications necessary for delivery vehicles and related ancillary equipment to achieve an acceptable level of acoustic nuisance. The programme was led by the Ministry of Housing, Spatial Planning & Environment and was conducted by the Dutch Research Institute NOVEM. The solutions demonstrated by the programme include modifications of vehicles greater than 7.5 tonnes to comply with low noise standards. On-board ancillaries were also

modified. Non-slam doors and silent reverse and signalling systems were added to vehicles. Finally, external ancillaries such as roll cages and trolleys that cause high noise levels (>65dB(A)) were also modified. Electric hand operated carts were found to be suitable for the final-link distribution on pavements. The Peak Programme offers a template for modifications to vehicles to ensure minimum noise disturbance for night deliveries.

MANAGING THE LAST MILE

While an urban distribution centre may be an option for managing deliveries before they reach the city centre, an alternative or indeed complementary solution involves managing "the last mile". Given the high proportion of deliveries originating in the city centre (17.5% of the total), it is appropriate to examine a delivery distribution strategy that focuses on the city centre area. The efficiency of the last link of the supply chain has important implications for urban traffic flows in the central business district (CBD). In other research, major barriers to freight mobility in New York's CBD were found to include: congestion throughout the CBD, inadequate docking space, inadequate curb space for commercial vehicles and a serious security problem (8).

These barriers are applicable to many other cities with congested CBDs. Therefore innovative solutions for managing the last mile distribution of goods in these congested areas are much needed. The down town "platform" concept is one way of managing distribution within designated areas such as large office complexes which are often located in congested city centres. The platform concept can offer logistical efficiencies such as consolidation at a local level, which mitigates distribution trips within the designated area. Furthermore, servicing the platform at off-peak times from external depots outside the city centre is another facility, which the concept could offer.

One city that operates the platform concept is Genoa in Italy through the M.E.R.CI project. The Ministry of Environment has financed the project through an environmental protection program. The project involves goods distribution via electric vehicles and a platform in the city (approximately 5km from the historic centre). A pilot version of the project commenced in March 2003. A wide variety of goods are distributed using the platform. However, fresh foods, jewellery, pharmaceutical supplies, newspapers are excluded. Deliveries to banks and offices are also excluded. Eight electric vehicles (EVs) are used in the project for deliveries, covering distances of between 12km and 20 km for each delivery (9). The platform itself is 1,100 m^2 in size. The implementation of advanced logistics management technologies at the platform allow for real-time control of delivery operations and optimal planning of goods delivery operations. Strong support for the pilot action from authorities, both financially and through the operation of restrictions in the city has allowed the project to be extended to the entire historical centre of the city.

A variation of the city centre platform scheme can be seen in Germany where Deutsche Post have introduced "PACKSTATIONs" for parcels in locations such as large office complexes, universities and filling stations. A PACKSTATION is a machine-based parcel retrieval system, which enables registered customers to retrieve and send parcels and small packages (10). The system notifies the recipient by text message or email once the parcel is ready for collection. Parcel collection is possible 24 hours a day with a customer card and personal PIN code. In June 2003, following three years of pilot operations in Dortmund, Mainz and Frankfurt, PACKSTATION was also made available to all Deutsche Post customers in Cologne. By the end of 2004, the cities of Hanover, Bremen, Darmstadt,

Wiesbaden, Munich, Augsburg, Hamburg, Berlin and Potsdam will be added to the PACKSTATION network. Up to 500 pack stations are planned for installation and at present, 320 are in operation. Wider benefits of the PACKSTATIONS include the fact that the company achieves a greater level of independence from special collection and delivery times, which enables improved route schedule planning and consolidation opportunities. Furthermore, unnecessary trips incurred when package recipients are not home are avoided as customers have greater control over when they wish to collect their package.

Dublin Case Study

Commencing in 1993, a major logistics service provider in Dublin experimented with the concept of a mobile platform or "Super Bus". The mobile station operated in central parts of the city from which walking couriers were deployed for local distribution. Supported by a small number of vans the operation proved to be an effective means of delivering to customers. However, in recent years, congestion and parking related difficulties proved problematic for the mobile station and it was decided by the company to replace the mobile bus with a fixed, premises-based platform in Dublin's south inner city. Since 2001 a substantial delivery operations platform has been operated for customers in a key strategic business district within a 1-kilometre radius of the operation base. The platform is serviced in the early morning by a delivery in a transit van from the main company hub at Dublin Airport Cargo Terminal. The van provides a shuttle service to and from the airport cargo terminal twice a day. The last mile deliveries are made by walking and cycling couriers or alternatively, parcels can be collected by customers. While the main purpose of the platform is to facilitate local distribution, it also serves as walk-in customer drop-off point for express mail and this mail is collected on the return trips from the airport. Under current arrangements, 16 to 18 walking and cycling couriers are deployed at the platform. Advanced ICT systems help to track consignments and to alert customers by e-mail regarding the status of their parcel. The platform handles letter post and light parcels, heavier parcels are delivered directly to customer premises by vans, as they are not suitable for delivery by walking couriers. The primary benefits of the platform operation may be viewed as the following:

- A reduction in the number of delivery drops by vans on congested city streets in the vicinity of the platform. It is estimated that over 1,000 items per day are now deliver by walking couriers instead of vans.
- The reduction in the number of deliveries by van to destinations in the city centre results in improved accessibility and reduced noise nuisance and emissions
- A reduction in the number of commercial vehicles accessing the city centre from the airport. It is estimated that 12 trips per day to the city centre are avoided
- Improved level of customer service and reliability. The additional step in the supply chain has not resulted in any significant delivery delays. The express parcel drop off facility is an additional service provided to customers

Despite the operational costs involved in the platform (rent, employees, equipment, security), the scheme offers potential for replication in other parts of the city centre. The criteria necessary to justify such a platform are:

1. Distributors must have a sufficient volume of deliveries to the city centre
2. Sufficient density of customers must exist within a selected area to justify the deployment of walking or cycling couriers

3. Convenient customer and vehicle access to the platform must be provided
4. Availability of secure premises for the platform

Financial institutions, government departments and other office facilities provide particular scope for replicating the platform initiative.

CONCLUSIONS

The aim of the freight distribution project is to assess freight delivery patterns and trends in Dublin City Centre. An analysis of a survey of deliveries to the city centre led to the examination of two specific freight delivery management strategies: the use of a UDC and a strategy relating to managing the last mile of deliveries. These strategies were examined as a result of the trends relating to the origin of deliveries. Specific examples of commercial companies were used for the strategy analysis.

The main findings and conclusions from the survey analysis are the following:

- Personally distributing delivery surveys to businesses proved a far more effective method than postal surveys.
- 55% of deliveries to the city centre were made in vans, while trucks accounted for 40% of the total
- Peak hour for deliveries was found to occur between 10:00 and 11:00 when 16% of the total arrived
- The two highest delivery generating zones were located in the south west of the city and in the city centre itself
- Due to the impact that materials handling can have on delivery operations and consolidation, a correlation exercise was carried out to examine the relationship between the type of packaging and the type of good. A correlation coefficient of 0.224 was obtained indicating a very mild relationship between the two variables
- 49% of deliveries used on-street parking for unloading goods. It was also observed that 39% of trucks parked on street for deliveries. This is a finding that has repercussions for city accessibility and further highlights the need for delivery management strategies.

Conclusions from the UDC case study and Managing the Last Mile case study are:

- Food is a prominent goods delivery category (38% of the total) and 38% of deliveries in this category were made by truck. The frequency and nature of food related deliveries necessitate a specific distribution strategy such as the use of a UDC
- The location chosen for the case study UDC was influenced to a large extent by the surrounding road network
- Use of the distribution centre in Kilcock, eliminates 501 deliveries each week to the city centre to 16 specific shops. This is because suppliers deliver direct to the consolidation centre instead of to individual businesses
- The distribution centre also assists in the process of backhauling which further reduces unnecessary truck trips
- Managing the last mile through the operation of a delivery platform in the city centre allows the delivery of over 1,000 items per day using walking or cycling couriers

- The additional step of a delivery platform in the city centre has not resulted in significant delivery time losses. Customer service and reliability are enhanced due to the fact that delivery times are not dependent on traffic congestion

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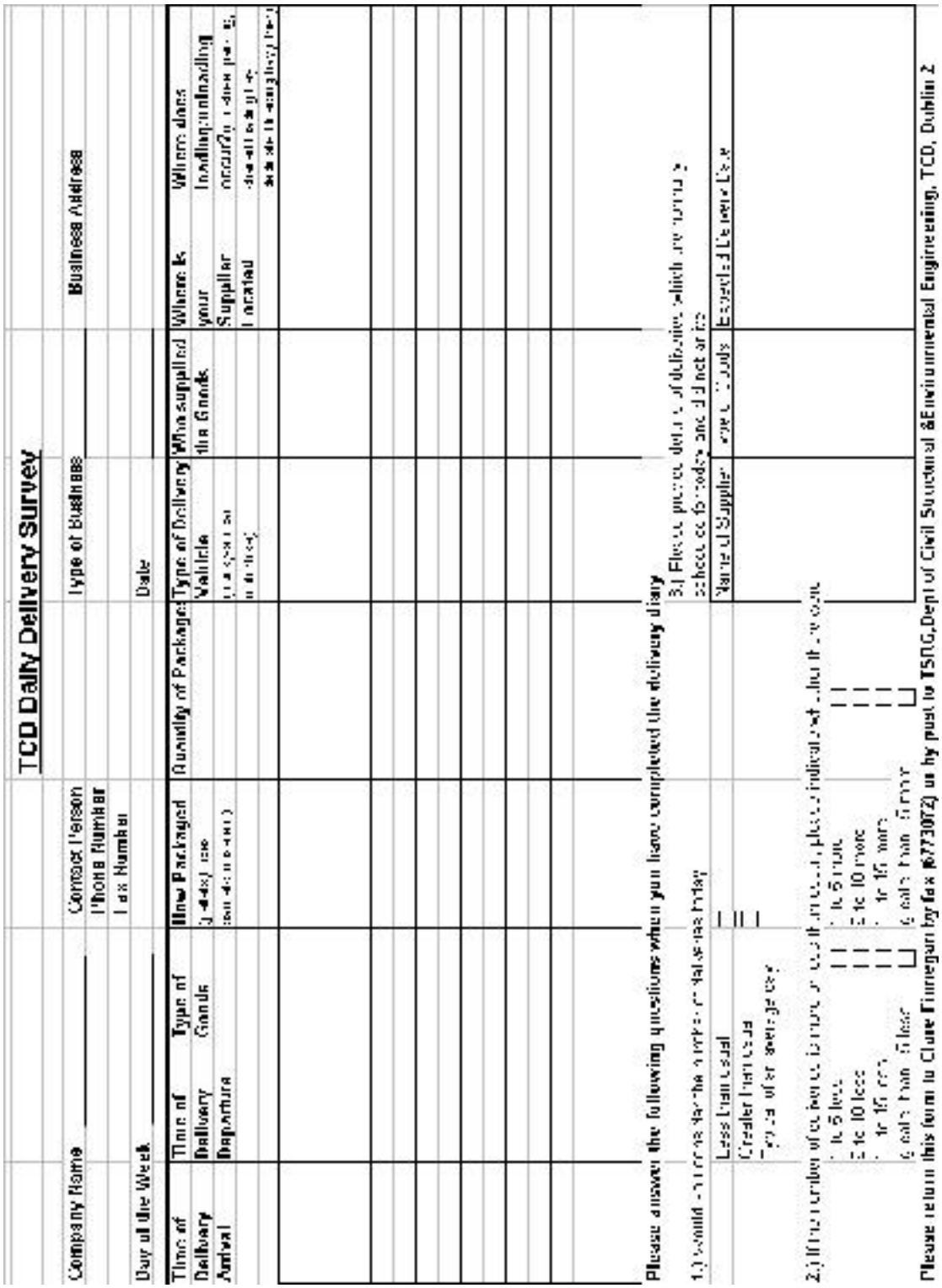

FIGURE 2 Frequency of deliveries arriving each hour

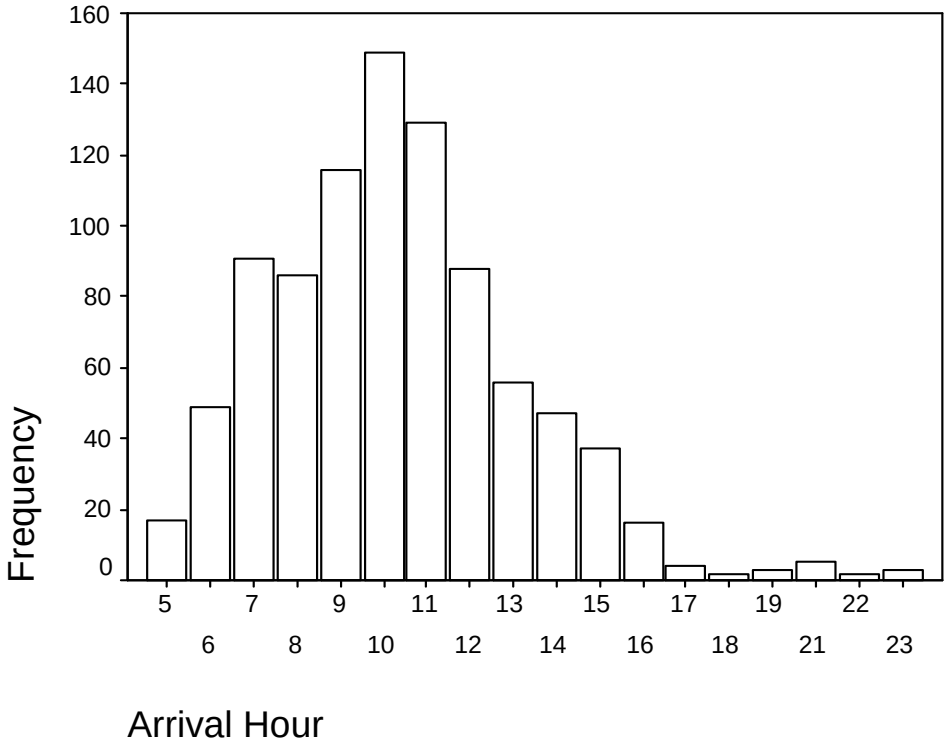

Figure 3 Zone system

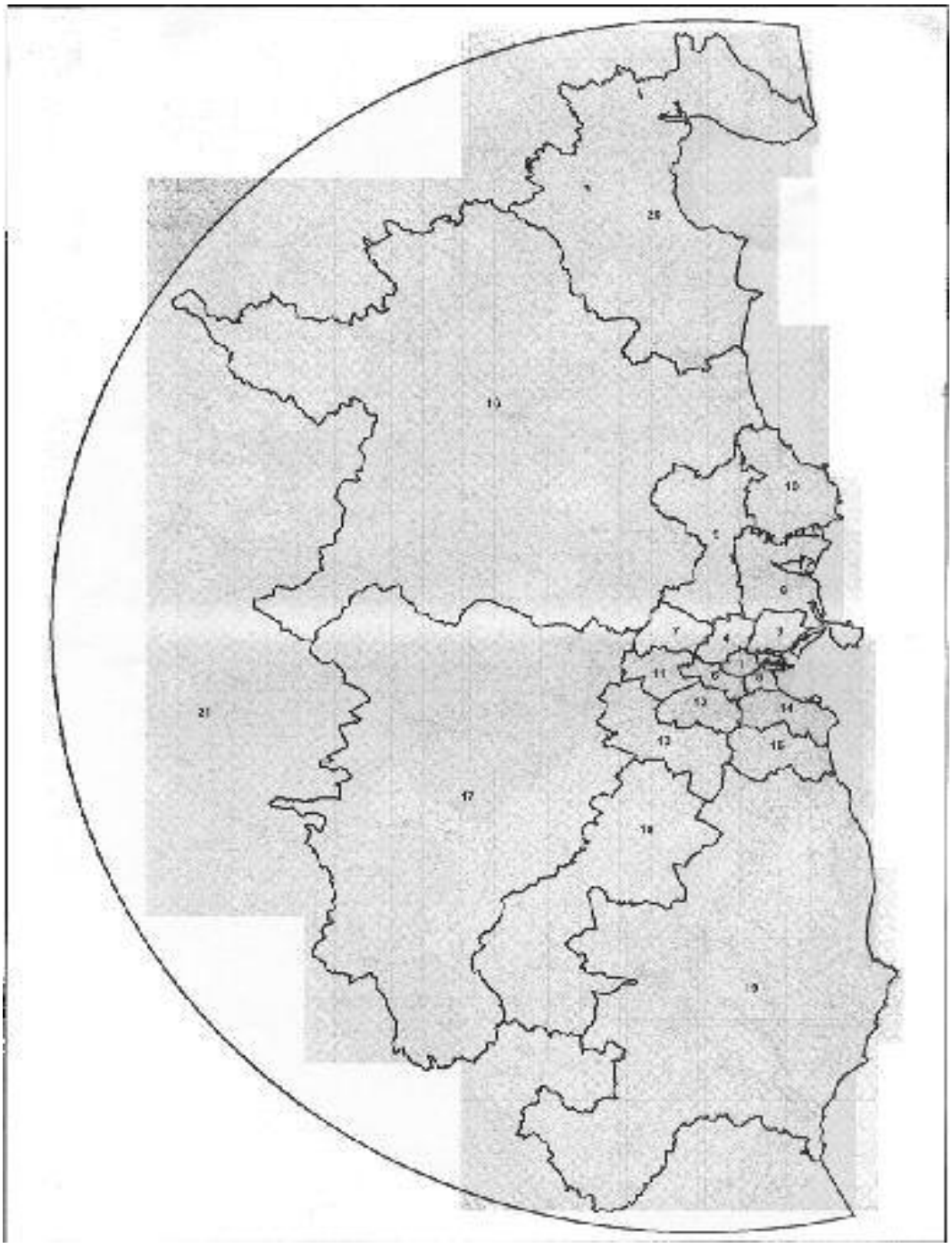

FIGURE 4 Road network at Kilcock distribution centre

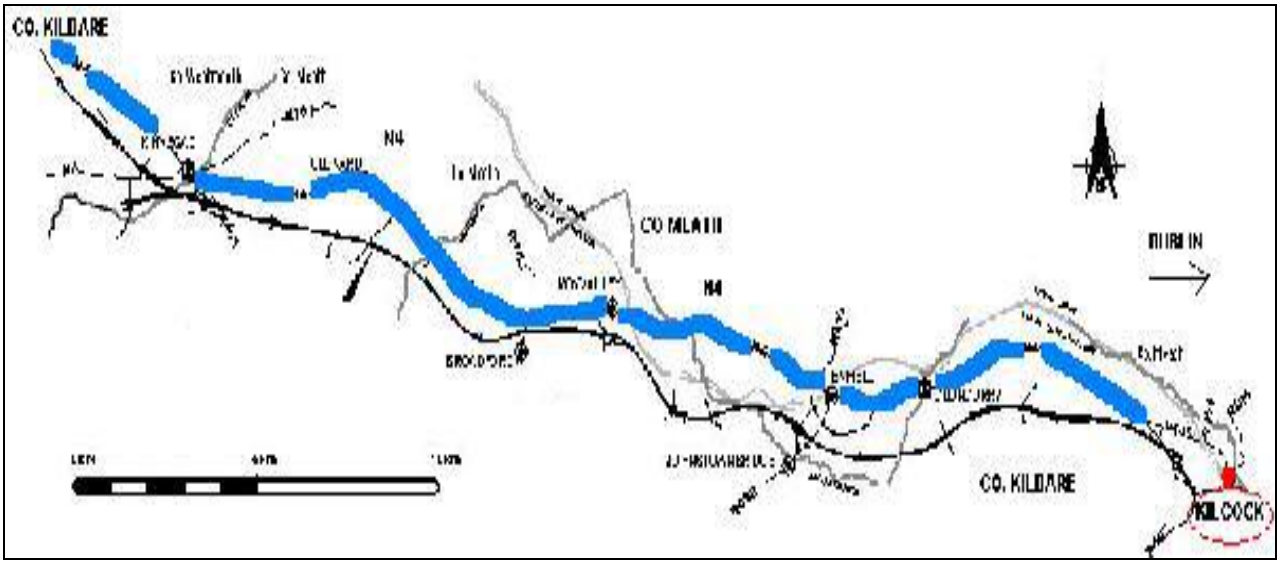

TABLE 1 Breakdown of the Number of Deliveries to Each Business Classification

	Frequency	Percent
Department Store	80	8.8
Restaurant/Food Retail	127	14.0
Pub	123	13.6
Hotel	95	10.5
Convenience Store	37	4.1
Newsagency	58	6.4
Retail (clothing)	36	4.0
Retail (Other goods)	185	20.4
Financial Instit/Office	68	7.5
pharmacy	41	4.5
Supermarket	26	2.9
Shopping Centre	30	3.3
Total	906	100.0

TABLE 2 Location of Delivery Origins using the DTO Zoning System

Zone Area	Zone number	Frequency	Percent
City centre (Central Business District)	1	159	17.5
Dublin Port area	2	8	0.9
North east city	3	15	1.7
North west city	4	62	6.8
South east city	5	10	1.1
South west city	6	185	20.4
Fingal west	7	20	2.2
Fingal east	8	34	3.8
Fingal north west	9	7	0.8
Fingal north east	10	0	0
South Dublin (Lucan, Clondalkin)	11	17	1.9
South Dublin (Tallaght)	12	95	10.5
South Dublin (Saggart, Rathcoole)	13	8	0.9
Dun Laoghaire/Rathdown north	14	44	4.9
Dun Laoghaire/Rathdown south	15	4	0.4
Meath	16	10	1.1
Kildare	17	16	1.8
West Wicklow	18	1	0.1
East Wicklow	19	13	1.4
Louth	20	8	0.9
Externals	21	62	6.7
Outside Ireland		114	12.6
Undefined		14	1.5
Total		**906**	**100**

TABLE 3 Breakdown of Types of Goods Originating from High Delivery Generating Zones

	Zone 1	Zone 4	Zone 6
Food/Beverages/General Catering Supplies	31%	47%	46%
Electrical Goods	.05%	6%	4%
Clothing/Shoes	6%	5%	4%
Household/Hardware Goods	6%	6%	7%
Stationary/Books/Newspapers	7%	13%	8%
Pharmaceutical Goods/Cosmetics	2.5%	11%	5%
Alcoholic Beverages	28%	5%	19%
Post/Parcels	8%	2%	2%
Miscellaneous Retail	11%	5%	5%

	Zone 12	Zone 21	Outside Ireland
Food/Beverages/General Catering Supplies	47%	26%	12%
Electrical Goods	0%	0.5%	7%
Clothing/Shoes	2%	18%	31%
Household/Hardware Goods	5%	21%	19%
Stationary/Books/Newspapers	10%	10%	18%
Pharmaceutical Goods/Cosmetics	20%	2%	3%
Alcoholic Beverages	13%	16%	2%
Post/Parcels	0%	0.5%	1%
Miscellaneous Retail	3%	6%	7%