Quick-response in the Frozen Food Supply Chain: The Manufacturers’ Perspective

Professor Alan McKinnon

Mr. Jim Campbell

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Appendix
1. INTRODUCTION

1.1 The Frozen Food Market

Frozen food has been steadily increasing its share of total food sales in the UK (Figure 1). Its share increased from 10.4% in 1991 to 11.0% in 1996. Over this period, the total value of frozen food sales rose by almost a quarter to £4.6 billion in 1996. It is predicted that this rapid rate of increase will continue at least until 2001, by which time frozen food sales will have expanded by a further 30% (at current prices)\(^1\).

\[
\begin{array}{c}
\text{1991} & \text{1992} & \text{1993} & \text{1994} & \text{1995} & \text{1996} & \text{1997} & \text{1998} & \text{1999} & \text{2000} & \text{2001} \\
\end{array}
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![Figure 1: Total UK Sales of Frozen Food*](image)


Frozen food is a heterogeneous sector, comprising a broad range of products which vary in the relative profitability and growth rates\(^1,2,3\). Ready-made meals have recorded the fastest rate of growth in recent years, reflecting the sharp increase in consumer demand for convenience foods (Figure 2). This has been reinforced by heavy investment in new product development and intensive advertising. Cakes/desserts and potato and meat products have also enjoyed a healthy growth, the latter appearing relatively unaffected by concerns about BSE. The only product group to experience a decline in sales has been poultry. This has resulted mainly from a major switch from frozen to fresh chicken and to ready-meals containing poultry.
A review of business directories suggests that in 1997 there were approximately 390 producers of frozen food products in the UK (see Appendix). This represents a continuation of the trend observed by Lindfield, who estimated that the number of frozen food manufacturers declined from 650 to 485 between 1990 and 1994. When set against the growth in total output, this reduction in the number of firms provides clear evidence of industrial concentration.

Despite this concentration, however, the frozen food industry remains highly fragmented. In 1997, 57% of the producers had annual sales of under £15 million. This degree of fragmentation is particularly high in some sub-sectors, such as fish and fish products, where many firms perform a basic freezing process and add minimal value to the product. Capital requirements at this end of the industry are relatively modest and entry barriers correspondingly low. Much freezing capacity is dispersed in small plants close to the main sources of raw foodstuffs, such as fish, vegetables and fruit. This minimises the time interval between harvesting and freezing, a key determinant of the quality of the frozen product.

The industry is, nevertheless, dominated by a few large manufacturers. The largest, by far, is BirdsEye Walls with approximately 20% of the branded frozen food market. UB-Ross Young, McCains and Findus (part of the Nestle group) together account for a further 14% (Figure 3). The larger manufacturers have achieved their greatest market penetration in the

1.2 Frozen Food Industry

Source: ref. [1]
ready-meals sectors, where they have been able to exploit their greater capital resources in the development and promotion of value-added products. They have been investing heavily in promotional activity to maintain brand shares. Despite this, however, a steadily increasing proportion of the frozen food manufactured in the UK is sold under the retailers’ brand names. It was estimated in 1997 that retailer own label products accounted for 44% of total frozen food sales. This is a measure of the degree of retailer influence in the frozen food market.

![Figure 3: Market Shares in the UK Frozen Food Sector](image)

Source: ref. [2]

### 1.3 Marketing Channels

It is estimated that the supermarket chains, co-operative societies and grocery discount chains now handle around 78% of all retail frozen food sales in the UK, a proportion that has risen from 66% in 1991. Freezer centres account for 16% and other, mainly independent, retail outlets for 6%. In volume terms the retail market represents roughly 84% of the total frozen food market in the UK, the remainder comprising catering outlets served mainly by wholesalers (often referred to as the ‘food service’ sector). As the supermarket and freezer centres chains buy directly from producers, only around a fifth of all frozen food sales are distributed via wholesalers.

### 1.4 Logistical Channels

Virtually all of frozen food sold through supermarkets chains is channelled through these firms’ regional distribution centres (RDCs). At present very little, if any, of this frozen food is cross-docked at RDCs. It is ‘put-away’ and stored in the racking for an average of 10 days before being picked and consolidated into mixed loads for shop delivery. In 1997,
just over three-quarters of all the frozen food sold in the UK was distributed via approximately 45 retail RDCs. There are wide variations in the number of RDCs at which the large grocery multiples hold stocks of frozen food: for example, Tesco does this at eight RDCs, Safeway at only three. Within the food services sector, there are numerous frozen food wholesale depots, providing a regional delivery service to catering outlets and smaller independent retailers.

Most frozen food is also stored and consolidated at warehouses upstream of the RDCs in the course of ‘primary’ distribution from the factory. Generally speaking, this primary distribution can take five forms:

1. Delivery directly from factory to RDC
2. Retailer-arranged collection from the factory
   (often by returning shop delivery vehicle)

Distribution via:
3. Dedicated cold store, owned or contracted by the manufacturer, often serving as a mixing / consolidation point for the output of several plants
4. Common- / shared-user cold store, contracted by the manufacturer
5. Primary consolidation centre ‘nominated’ by a retailer

Figure 4 illustrates the different routes that frozen food can follow between factory and shop. No data are available on the division of frozen food flows among these various routes, though the most important routes are marked by darker lines. In recent years, retailers have been exerting a stronger influence over the primary distribution of frozen food, partly by directing inbound supplies into nominated consolidation depots but also by collecting a small, but increasing, proportion of their orders directly from factories or manufacturers’ cold stores, often as backloads on returning shop delivery vehicles. This is effectively integrating the primary distribution of supplies from factory to RDC with secondary distribution from RDC to shop. This practice is discussed more fully in section 4.5.
2. ECONOMIC AND ENVIRONMENTAL IMPORTANCE OF FROZEN FOOD LOGISTICS

2.1 National Expenditure:
Lindfield estimates that the cold chain handles around 2.2 million tonnes of frozen food per annum, approximately 40 kg per capita. In the course of the present study an attempt was made to estimate the total cost of this distribution operation, comprising transport, warehousing and inventory costs. This calculation is based on survey estimates of manufacturers’ and retailers’ expenditure on distribution expressed as a percentage of sales revenue. This suggests that the physical distribution of finished frozen food products from factories to shops and catering outlets costs around £450-500 million annually.

2.2 Energy Consumption:
Recent research by the Energy Technology Support Unit and Heriot-Watt University / Cold Storage and Distribution Federation has provided estimates of the amounts of energy consumed in storing and transporting pallet-loads of frozen food. It suggests that on average a cold store consumes the equivalent of approximately 3 litres of fuel in holding a pallet of frozen food. Transporting it from factory to RDC via a cold store, on average, consumes a further 11 litres of fuel, given typical lengths of haul and vehicle load factors. Of that, roughly 2.8 litres are consumed by the vehicle’s refrigeration unit over the 12 hours, or so, that the average pallet spends in a trailer on the way to and from the cold store, almost the same energy as is consumed storing the pallet for the 5.7 weeks typically spent in cold storage at a temperature up to 10°C lower. Refrigeration accounts for roughly 40% of the total energy requirement, making the distribution of frozen food around 1.7 times as energy-intensive as the distribution of groceries at ambient temperature.

The ETSU and CSDF / Heriot-Watt surveys studies revealed wide variations in the amounts of energy consumed in cold storage and refrigerated transport operations. The mean energy consumption per cubic foot in cold stores varied from 0.95 kW to 3.5 kW, while across a sample of ten firms’ transport operations average fuel use (by both the tractor unit and the refrigeration equipment) ranged from 16.7 to 45.4 millilitre / pallet / km. Some of this variation will be attributable to differences in the nature of firms’ distribution operations. It is also likely to reflect differences in energy efficiency, suggesting that there may be significant potential for reducing total energy consumption in this sector.

Improvements in energy efficiency would not only cut distribution costs, but also reduce atmospheric emissions. The use of diesel-powered refrigeration equipment substantially increases the level of emissions per tonne of product distributed. Unlike lorry tractor units, which have been subject to tightening EU emission standards, the refrigeration motors on much of the nation’s ‘reefer’ trailer fleet continue to produce high levels of noxious emissions per litre of fuel consumed. Moreover, as these trailers have a much longer working life than the typical tractor unit, the rate at which this refrigeration equipment is replaced and upgraded is much slower. The potential environmental benefits from increasing energy efficiency are, therefore, relatively high in this sector.

Efforts to improve the economic and energy efficiency of the cold chain are being made against a background of operational and structural change. Some of the changes that firms
are making are clearly enhancing efficiency, while others are having the opposite effect. To investigate current logistical trends in this sector more fully, interviews were held with senior managers in forty-two frozen food manufacturing firms during January and February 1998. This provided a detailed insight into current practices, trends and concerns. Information about the survey can be found in the Appendix. The remainder of the paper reports the results of this survey.

3. LOGISTICAL PRESSURES

3.1 Quick-response
Firms were asked what the main pressures for logistical change had been over the previous three years. There was almost unanimous agreement that the main pressure was customer demand for reductions in order lead time and more frequent delivery of smaller quantities. This drive for ‘quick-response’ came primarily from the major supermarket chains, which accounted for 61% of the total sales of firms in the sample. They were pursuing a ‘quick-response’ strategy much more aggressively than wholesale customers. This can be attributed to two factors:

1. Desire to cut inventory levels and thus increase the stockturn rate:
The four largest supermarket chains, Tesco, Sainsbury, Asda and Safeway, reduced their average stockholding of frozen products from 12.0 days to 11.2 days between 1996 and 1997.

2. Limited cold storage capacity in RDCs
The main era of retail RDC development in the UK appears to be over. Between 1985 and 1990, supermarket chains built 20 new RDCs. Since 1990 only seven have been built. Retailers are trying to use their existing facilities much more intensively. The top 4 supermarket chains increased their average warehouse space utilisation from 82.7% to 85.8% between 1994 and 1997. Given seasonal fluctuations in warehouse throughput, this means that RDCs are working very close to full capacity. The desire to ‘sweat’ existing RDC assets applies particularly to cold storage capacity, as this is by far the most expensive warehouse space to construct and operate.

Across the firms surveyed, average order lead times had shortened from 6 days to 3.7 days, with receipt of order on day 1 for delivery on day 3 now the norm for all but the smallest
manufacturers (Figure 5). The larger manufacturers were, on the whole, providing more rapid delivery than smaller ones. When weighted by turnover, the average order lead time had fallen from 4.1 to 2.7 days. For a given size of firm, there was little variation in order lead times between product groups. Average frequency of delivery had risen from 2.1 per week in 1995 to 3.2 per week today. As one would expect, average delivery frequency was higher for larger manufacturers. Most of these firms are providing daily deliveries to major customers.

![Figure 5: Average Order Lead Time and Delivery Frequency, 1995 to 2001](image-url)

Just over half the manufacturers consulted believe that average order lead times will continue to shorten and delivery frequencies increase over the next three years. The forecast changes in these indices over the next three years, when averaged across the sample, broadly extrapolate the trends experienced over the past three years (Figure 5). There was a general consensus among the larger manufacturers that day 1 for day 2 would become the standard, with the more ‘progressive’ retailers demanding day 1 for day 1 from their bigger suppliers. This presents logistics managers in this sector with a formidable challenge, particularly as many firms are already struggling to meet retailers’ current delivery specifications (Figure 6). Few manufacturers anticipate making more than one delivery a day.
3.2 Seasonal Fluctuations and Promotional Activity

The problem of meeting these requirements is compounded by the inherent variability in the frozen food supply system. Much of this variability is the result of seasonal fluctuations in the availability of raw materials and/or consumer demand (Table 1). Two-thirds of the firms surveyed claimed to be subject to seasonal fluctuations other than the general build-up for the Christmas peak. These firms were affected much more by variations in final demand than by the seasonality of raw material inputs. One of the larger firms, for example, has two-thirds of its annual sales concentrated in a four month period. There was a general acceptance across the sample of this type of variability.

Table 1: Seasonal Effects

<table>
<thead>
<tr>
<th>% of Firms</th>
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<tbody>
<tr>
<td>seasonal supply of raw materials</td>
</tr>
<tr>
<td>seasonal demand for finished product</td>
</tr>
<tr>
<td>both seasonal supply &amp; demand</td>
</tr>
<tr>
<td>no seasonal effect</td>
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Logistics managers were much more concerned about the destabilising effect of promotional activity, which many saw as a self-inflicted problem. For a larger manufacture, a promotion can represent a one-off flow of over 100,000 cases of specially-packaged product, which must reach the shops at a specified time, usually to synchronise with an advertising campaign.
A large proportion of frozen food is sold on promotion, for several reasons. First, much of it comprises relatively cheap, commodity-type products with low brand-loyalty and high price-sensitivity. Short-term price reductions can significantly inflate demand. Second, much promotion aims to maintain or increase market share for manufacturer-branded products and stem the relentless growth of retail own label sales. Third, some manufacturers use promotions to try to offset seasonal fluctuations, thereby reducing overall variability. Most promotional activity, however, has the effect of amplifying variations in the volume of flow.

Promotions have become an intrinsic feature of the frozen food market, an accepted way of marketing frozen products. As one manager explained, ‘consumers have been conditioned only to buy frozen food on promotion’. This would make it very difficult to scale down the level of promotional activity. One firm in the survey claimed to have attempted this unilaterally and suffered a significant drop in sales. There is no evidence that the industry is prepared to act collectively to curb promotional campaigns. One of the central tenets of Efficient Consumer Response \(^{11}\), that short-term promotions are replaced by a commitment to ‘everyday low prices’, is being largely ignored in the frozen food sector. On the contrary, over half the manufacturers’ consulted expected there to be a large increase in promotional activity over the next three years and a further 24% predicted that it would increase slightly (Figure 7).
4. ADAPTING THE FROZEN FOOD SUPPLY CHAIN TO QUICK-RESPONSE

This section will examine the ways in which frozen food manufacturers are responding to quick-response pressures in the supply chain. It begins by assessing the scope for increasing the flexibility of production operations and thereby matching supply and demand more closely at factory level. Production scheduling is only one of many factors affecting inventory levels in the supply chain. The second part examines recent inventory trends and considers how stock levels are likely to change over the next three years. Part three considers whether there is adequate cold storage capacity to accommodate this inventory and assesses the suitability of the warehouse racking, handling and operating systems for the quick-response regime. The section concludes with a detailed review of the transport implications of quick-response. This focuses on efforts to consolidate loads and thereby maintain the efficiency of the transport operation.

4.1 Production Scheduling

In an ideal world, the principle of quick-response would penetrate the manufacturing operation, reducing lead times and batch sizes and closely synchronising production with distribution. In practice, however, the frozen food industry is characterised by relatively long lead times and production runs. Given the price sensitivity of most frozen food, firms are under strong competitive pressure to minimise unit production costs by manufacturing in large batches.

The flexibility of the production operation is further reduced by the seasonality of both supply and demand. The processing of seasonal vegetables, for instance, must be concentrated at particular times of the year, while that of livestock is constrained by the life-cycle of the animal or poultry. Where demand is subject to a high seasonal peak, it is usually necessary to build stocks, partly to smooth the manufacturing work-load but also because there is insufficient production capacity to meet peak demand within the required lead times. One ice-cream manufacturer, for instance, only has production capacity to meet half the demand for its products in the summer months.

The survey respondents were in the main logistics and distribution managers, many of whom were unable to give quantitative data on batch size. Among the few firms able to
give historic data, no clear trend emerged: similar numbers reported a decline in average batch size as reported an increase. The managers consulted, however, particularly those in the large firms, believed that batch sizes could be reduced by a significant margin in the future (Figure 8). Production managers would no doubt have expressed a different view. One senior manager argued that ‘even among the most progressive frozen food manufacturers too little is done to co-ordinate production and logistics scheduling.’ One of the major firms in the sector, nevertheless, reported that it had modelled the effects of differing production scenarios on the supply chain and was aiming to improve the trade-offs between production economies and downstream logistics costs.

4.2 Inventory

It has been suggested that quick-response is pushing inventory back along the cold chain. Retailers have been accused of reducing their inventory levels at the expense of their frozen food suppliers who must then shoulder greater responsibility for stockholding. If this were true, the average stockturn rate (i.e. the ratio of sales to inventory) in the frozen food manufacturing sector should be declining.

Thirty-six of the companies surveyed were able to provide data on stock cover. 58% of these firms, reported that over the past three years they had increased their stockturn rate, three times as many as had experienced a reduction (Figure 9). On average, stock cover had been reduced by roughly 10%. When weighted by company turnover, this average
increased slightly to 15%. On balance, therefore, it seems that firms are managing to meet tightening retail requirements while improving stockturn rates.

One must exercise caution, however, in examining the link between manufacturers’ stockturn rates and quick-response pressures. These stockturn rates are, after all, affected by many other factors and vary enormously across the frozen food industry. Stockturn rates, for instance, can vary from 25 times per annum for frozen fish or chips to 4 times a year for ice-cream. In those sectors subject to wide seasonal fluctuations in raw material supply and/or consumer demand, stockturn is relatively low and affected mainly by the need for stockbuilding ahead of peak demand.

![Figure 9: Trends in Stockturn Rates](image)

Inventory levels are also affected by the diversity of the product range. As a general rule, the greater the number of stock-keeping units (SKUs) the higher the inventory level. Across the sample, the average number of SKUs had risen by around 5% over the previous three years as firms broadened their product portfolios. Other things being equal, this might have been expected to have reduced average stockturn rates.

Despite quick-response and product proliferation, the majority of firms had managed to maintain or improve stockturn rates. This they attributed mainly to four inter-related factors:

- adoption of new and improved inventory management systems
• more effective use of IT
• concentration of inventory at fewer locations
• more accurate forecasting

A few firms also commented that a lack of cold storage space had given them an added incentive to cut stock levels.

Of the manufacturers who expressed a view on the future trend in stockturn rates, opinion divided fairly evenly between those predicting a further increase over the next three years and those expecting it to stabilise (Figure 9). Only four of the firms believed that stockturn rates would decline over this period. Overall, therefore, managers did not anticipate a large net migration of inventory back along the supply chain. Inventory levels at the manufacturing level would be likely to increase at or slightly below the growth rate for total frozen food sales.

4.3 Warehousing
The survey revealed wide dissatisfaction with cold storage facilities, in terms of both the available capacity and the nature of the racking and handling systems.

Capacity:
Approximately 38% of the firms claimed that a lack of cold storage space was posing a serious problem (Figure 10). Curiously, a similar proportion did not consider this a problem. Among the former category, however, were many of the larger companies.
It is difficult to generalise about this issue for several reasons:

(i) Storage requirements can vary enormously during the year, as a result of seasonal fluctuations, promotional activity and even the weather. For many firms, the problem is that of accommodating peak volumes at particular times of the year.

(ii) Different firms are at different stages in the warehouse investment cycle. Those that have recently invested in new facilities will have excess space relative to current needs, whereas those at the end of the cycle will be working at full capacity.

(iii) Firms vary in the relative extent to which they contract out their cold storage.

(iv) There are geographical variations in the availability of cold store space, with some firms reporting difficulty in finding adequate third-party refrigerated warehousing in particular areas.

A shortage of storage space can impose a physical constraint on stock levels and thus have the beneficial effect of promoting tighter inventory management. Working too close to full capacity can, however, impair the efficiency of the materials handling operation.

It can also indirectly affect the use of the transport fleet. It is common practice in the frozen food industry to use refrigerated trailers as overspill storage space. This partly explains why in a recent survey of 1300 refrigerated trailers over a 48 hour period, it was found that roughly a fifth of their time was spent loaded and stationary. The logistics director of a company which makes heavy use of trailers for this purpose admitted that expensive transport assets were being used to compensate for deficiencies in the warehouse system.

The fact that ‘reefer’ trailers spend so much of their time standing fully loaded is not simply a consequence of space limitations in the cold stores. It also reflects the widespread practice of pre-loading in the frozen food industry. This is done primarily to spread the workload and improve the average utilisation of staff and equipment in the cold store. As vehicles are typically dispatched over a fixed period of 6-8 hours, loading them immediately
prior to departure would increase the resource requirements at these critical times. This would require much more flexible use of staff and greater investment in handling equipment.

It is also quite common for firms to co-ordinate the assembly of outbound loads with the ‘put-away’ of inbound consignments. Having delivered an inbound pallet to a racking position, a fork-lift truck can be ‘backloaded’ with another pallet load for outbound delivery. This maximises the efficiency of the materials handling operation. This operation is often driven by inbound flows from the factory, particularly as many factories have very limited on-site cold store capacity. These inbound flows usually arrive and are put-away at regular intervals during the working day, to be counterbalanced by the retrieval of outbound loads. These loads therefore accumulate during the day at the despatch bay. Often there is inadequate space at the despatch bay to accommodate them, in which case they are loaded straight onto trailers. This removes the need for double handling, but results in products spending much longer in the trailer, which is a much more expensive and less energy-efficient cold storage unit.

**Racking and Handling Systems:**
Two out of five of the firms consulted considered cold storage facilities to be unsuited to the new order picking and handling requirements they were expected to meet (Figure 11). Much of the cold store capacity in the UK was built at a time when frozen food typically spent a much longer time in storage than today. Product ranges were much narrower and there was less need to assemble mixed orders. The main emphasis was placed on maximising cube utilisation and thereby minimising warehouse space and energy consumption. This was achieved by block stacking products, often with frameworks of ‘irons’ built around pallets, or by the use of mobile racking. One manager described this as ‘an engineering solution’ which did not pay sufficient regard to the real needs of distribution managers. It extended the ‘batch production mentality’ into cold storage, assuming that products would move into and out of the warehouse in large discrete loads, stored during the intervening period of weeks or months in a tightly-packed mass. The slow rate of throughput in the past meant that the doors opened and closed relatively infrequently and the level of activity within the cold store was quite low. This too helped to conserve energy.
The acceleration of the stock-turn rate, the proliferation of frozen food products, increasing customer demand for mixed orders and the shortening of order lead times has radically altered warehousing requirements in this sector. There is now a much greater need for adjustable racking offering direct access to individual pallet locations for quick and easy retrieval. One firm estimated that it took 3-4 times as long on average to assemble a lorry load where the pallets had to be retrieved from mobile racking. Although direct access requires more aisle space, it can represent a trade-off between space / energy costs and distribution / service needs that is more closely aligned with current market conditions.

4.4 Transport

In essence, quick-response entails more frequent delivery of smaller orders. Other things being equal, one would expect it to reduce the average size and weight of consignments. Across the sample as a whole, average consignment size has, in fact, declined from 11.7 pallets to 9.8 over the past three years (Figure 12). It was predicted that this average would drop further to 8.4 pallets by 2001. When these averages were weighted by company turnover, however, a different picture emerged. This suggested that the average order size had been fairly stable and would drop only slightly over the next three years. Several of the larger firms acknowledged that quick-response had been exerting a downward pressure on order size but this had been largely offset by an underlying growth in sales volumes.
It is frequently alleged that the move to more frequent ordering of smaller quantities is reducing vehicle load factors and thereby generating extra lorry traffic per tonne of product delivered. The study tried to examine the extent to which this was happening in the cold chain.

It is important at the outset to emphasise the distinction between order size and vehicle payload. As several orders can be consolidated in a single load, a decline in average order size need not result in a contraction of the average payload. Assuming that the capacity of the vehicle remains unchanged, a reduction in average order size can be offset by an increase in the degree of load consolidation. The survey evidence suggests that several developments have been increasing the level of consolidation:

- concentration of production capacity in fewer plants; in some cases this has followed company mergers / takeovers, in others it has involved the internal restructuring of a single firm’s product operation.

- concentration of manufacturers’ cold storage space at fewer sites:

- concentration of retailers’ cold storage capacity in fewer RDCs, resulting in flows of frozen food being channelled through fewer locations: for example, between 1993 and 1998, J. Sainsbury reduced the number of RDCs with a cold store from 13 to 4.
• greater use of third-party consolidation services provided by logistics service firms

These trends have tended to counteract the downward pressure on order sizes which many firms reported. The net effect on vehicle utilisation is difficult to determine, however. This is partly because many of the firms consulted were unable to provide utilisation data but also because of difficulties in establishing a consistent measure of vehicle loading.

Company awareness:
Manufacturers in the sample can be divided into three general categories:

1. Firms with own-account transport operations: approximately 40% of the firms surveyed operated their own vehicles, though these sometimes carried only a small proportion of the sales volume.

2. Firms which contracted out the transport operation on a solely or predominantly dedicated basis: these tended to be bigger firms with sufficiently large volumes to achieve high utilisation on vehicles carrying only, or mainly, their products.

3. Firms which contracted out their transport on a common / shared user basis.

Only firms in categories 1 and 2 were able to provide hard data on utilisation. Firms employing common / shared user services had little knowledge of vehicle load factors. They were much more interested in a contractor’s charges than in the efficiency with which it operated its vehicles.

Measurement of vehicle load factors
Load factors can be expressed in terms of weight, volume or the proportion of deck-area occupied. As cube and deck utilisation are, in practice, very difficult to measure and as virtually all frozen food movements are palletised, the use of vehicle space is generally expressed in terms of pallet numbers.

Just under a third of the firms with own-account or dedicated contract transport reported that their loads were mainly weight-constrained. These firms handled mainly poultry and
vegetables. Many companies reported that only a small proportion of their loads was weight-constrained. One of the largest firms in the sector, for example, producing a broad spectrum of frozen food products, claimed that only around one load in three-hundred was be weight-constrained. As far as the outbound distribution of finished product is concerned, therefore, the frozen food industry would derive limited benefit from an increase in maximum lorry weight.

Several firms whose operations have been constrained by the lorry weight limit (of 38 tonnes) claimed that this was becoming less of a problem as the proportion of weight-constrained loads was diminishing. This was the result mainly of two trends:

a) shift from frozen to chilled products and from ‘commodity’ products to ready-meals, i.e. lower density products.

b) migration of the order-picking function back along the supply chain, resulting in an increase in the proportion of pallets with a mixed range of products for particular customers. These pallet-loads are invariably lower and lighter. One major producer reported that between 1995 and 1998 it had increased the proportion of ‘order-picked’ pallets from 5% to 15%.

Another large manufacturer, which was subject to both these trends, had experienced a decline in average weight utilisation, but been able to increase the average number of pallets carried per trip. The average stacking height of these pallets had fallen, however, reducing the cube utilisation of the vehicle. This illustrates how different utilisation indices can move in different directions and how the trend in a single index can give a misleading impression.

Declining load density and stacking heights in other sectors have encouraged the use of double-deck trailers. There is little evidence as yet of a similar trend in the frozen food sector. Refrigerated double-deck trailers are still a rarity on the UK road network, though several of the manufacturers surveyed claimed to be assessing their potential.

By far the most commonly used index of vehicle utilisation in this sector is the ratio of the actual number of pallets carried to the maximum that could be carried. Across the sub-sample of manufacturers able to provide this data, the average utilisation was in the range
80-85%, equivalent to 21-22 pallets being carried on a trailer with a 26 pallet capacity. Almost all these firms indicated that the level of utilisation, thus defined, had either remained stable or increased slightly. This average utilisation is very similar that of 640 manufacturer-controlled deliveries surveyed over a 48 hour period in October 1997 as part of the vehicle audit commissioned by the CSDF and ETSU, which was referred to Section 2.2. As the majority of these deliveries were made by third-party logistics firms on a shared-user basis, utilisation levels appear to be fairly uniform across the three categories of manufacturer listed above.

The majority of firms did not consider vehicle utilisation to be a major problem (Figure 13). Around 60% of those with own-account / dedicated contract operations hoped to be able to improve load factors over the next three years. Discussions with those firms that had control over vehicle loading, nevertheless, revealed some concern that quick-response pressures will make it hard to maintain current load factors, both in terms of pallet numbers and pallet heights.

![Figure 13: Concern about the Level of Vehicle Utilisation](image)

**4.5 Load Consolidation Strategies.**

*Manufacturer-controlled consolidation*

The key to improved utilisation lies in a firm’s load consolidation strategy. The largest manufacturers can generate sufficient volumes from a single plant or adjacent cold storage to provide full lorry loads on a daily basis to RDCs. Such direct factory-RDC links are comparatively rare, however. In the case of multi-plant firms, the outputs of several plants are often consolidated at a dedicated cold store, either operated on an own-account basis or
by a logistics contractor. A dedicated consolidation operation of this type again requires large and relatively stable volumes to be viable.

The vast majority of firms lack the necessary throughput to support a dedicated system capable of providing daily delivery economically to major customers. They, therefore, channel their products through shared-user facilities run by logistics service firms. There are wide variations in the nature and extent of this sharing. At one extreme are ‘quasi-dedicated’ operations dominated by a single large client and ‘topped-up’ with third-party business. At the other, are true common-user cold stores handling the products of many firms, none of whom would account for more than, say, 10% of throughput.

This grouping of different firms’ products not only increases vehicle load factors: it can also reduce the number of drops per delivery and ensure tighter adherence to schedule. The mixing of products with different seasonal cycles can also help to stabilise load factors during the year.

**Retailer-controlled consolidation**

Retailers have forced many frozen food suppliers into a second level of consolidation, refusing to receive their orders directly into RDCs and directing them instead through the cold stores of nominated ‘consolidators’. These consolidators are often the same contractors that handle distribution for the manufacturers and, on occasion, a manufacturer will hold stock in the same cold store that a retailer has nominated as its regional consolidation point.

The majority of the firms surveyed did not regard the use of retailer-nominated consolidation points as problematic (Figure 14). Around 30% of the sample did, however, and among them were some of the larger firms. Several had successfully resisted pressure from the supermarket chains to deliver via consolidators. Some firms objected to the fact that it inserted an extra node and link into the supply chain, adding cost and delay. Several commented that this had been necessitated by retailers’ failure to upgrade their RDCs to cope with the demands of their own system of quick-response replenishment.

One particular grievance was the system of charging for the use of these nominated consolidation services (Figure 15). Some manufacturers complained that the charges the
supermarket chains imposed for RDC delivery via a nominated consolidation point were excessive. It was frequently alleged that they were ‘profiteering’ by adding an extra margin to the contractors’ rates. Several of the larger producers also objected to the charging of an average per pallet rate for these services on the grounds that, with their greater volumes, they were effectively cross-subsidising smaller suppliers. Elsewhere in the third-party logistics market pallet rates were highly volume-sensitive and this, it was argued, should also apply to distribution via nominated consolidation points.

One poultry supplier complained that they were not only being overcharged for the use of nominated carriers, but also receiving a standard of service, in terms of refrigeration and product care, which sometimes fell below its own internal standards and, indeed, those actually stipulated by the retailer. This had been drawn to the retailer’s attention, but no action had been taken.
The survey uncovered evidence of manufacturers exploring ways of bypassing the retailer-controlled consolidation system. One firm, which already had a frozen food network covering much of the country and a solid base load of internal traffic, was considering offering a consolidation service for particular retailers at rates significantly below those currently being charged. Several others were discussing the possibility of some form of collective action to boycott the retailer-controlled schemes and establish an alternative system.

Criticism of the supermarket chains was not confined to the nominated consolidation system (Figure 16). Over 60% of the sample were concerned about goods reception arrangements at RDCs. A frequent complaint was that vehicles arriving at the appointed booking-in time, were having to wait for unloading, sometimes for several hours. The severity of this problem varies between both retailers and RDCs. One large manufacturer which delivers on a daily basis to most RDCs around the country, reckoned that about 20% of them were responsible for 80% of the delays.

Various suggestions were made for improving this situation:

- retailers should overhaul RDC reception operations, investing in improved facilities and employing more staff
- adoption of fixed booking times for larger suppliers making regular daily deliveries
- suppliers and contractors should be allowed to charge demurrage where the unloading of a vehicle is seriously delayed
- investment by manufacturers and contractors in IT systems capable of giving RDCs advance warning of arrival times and delays
• increased use of ‘green lane’ systems at RDCs where the offloading operation is not delayed by the need to inspect loads and paperwork

*Ex-works Collection*

Another way of alleviating reception problems at RDCs is to allow the retailer to arrange collection of orders directly from the plant. There has been a steady increase, over the past few years, in the proportion of grocery supplies collected by retailer. Manufacturers’ opinions on this practice were quite sharply divided (Figure 17). The majority of firms were either supportive of this initiative or did not regard it as a significant issue. Many of them had no experience of ex-works collection. On the other hand, around 20% of firms were quite strongly opposed to the practice. Their main objection was that it reduced the volume of flow through their main distribution system, increasing average unit costs. Some saw this as the retailers improving the utilisation of their fleets at the manufacturers’ expense. It was also argued that despatch operations at the plant / cold store were not ‘geared up’ to having orders ready for collection at particular times when it was convenient for the retailer’s vehicle to call.

![Figure 17: Concern about Ex Works Collection by Retailers](image)

A recent survey by the Institute of Grocery Distribution (IGD) suggests that, despite reservations on the part of some manufacturers, there appears to be general agreement among retailers, suppliers and logistics firms that the backloading of shop delivery vehicles with ex-works collections of frozen food will continue to grow.

*Role of the Logistics Service Provider (LSP)*

27
Third-party logistics firms play a key role in the consolidation of frozen food supplies to RDCs, working on behalf of both the manufacturer and the retailer. Quick-response pressures have forced firms to make greater use of their shared-user services and this trend is likely to continue. As Lindfield\textsuperscript{d} notes, ‘Notionally a consolidation centre of 25-30,000
pallet spaces of manufacturers’ products will support consolidated full loads on a daily basis to most major RDCs’.

Although manufacturers have been increasing their dependence on LSPs and recognise that they fulfil an essential role, there is significant dissatisfaction with the standard of service that they receive. Just over half the firms surveyed believed that this presented a serious or very serious problem (Figure 18). Further investigation revealed that, for most firms, the deficiencies did not lie in the general reliability of the service. With a few notable exceptions, this usually conformed quite closely to the contract specifications. The main complaints related to a lack of innovation and investment. LSPs were accused of not being sufficiently proactive, echoing views expressed by many of the respondents to a PE Consulting survey of third-party logistics in 1996. Many of the managers consulted also argued that the sector was suffering from under-investment in modern storage and materials handling equipment. There was a good deal of praise, however, for those LSPs which had recently upgraded their facilities and were making more effective use of IT.

![Figure 18: Concern about the Standard of Service Provided by Logistics Firms](image)

5. FUTURE DEVELOPMENT OF QUICK-RESPONSE

The survey sought manufacturers’ views on the future course for quick-response in the cold chain. This focused on two possible developments, the cross-docking of frozen food in RDCs and a requirement for suppliers to ‘pick-by-store’.

**Cross-docking:**

This would involve retailers receiving, sorting and despatching frozen food within, say, an 8-10 hour time-frame. It would not be ‘put away’ in the racking for short term storage.
Instead, inbound deliveries of frozen food would be ‘picked-to-zero’ on a daily basis. Frozen food would then be treated in a similar fashion to fresh and chilled product.

It is understood that, at present, no frozen food is cross-docked in this way at retail RDCs. There is wide expectation in the industry, however, that this will begin to happen over the next 3 years. 61% of the manufacturers surveyed thought that there would be a ‘significant increase’ in this practice over this period and a further 21% a ‘slight increase’ (Figure 18). Among the top ten manufacturers, 90% reckoned that it would increase, though the balance between ‘significant’ and ‘slight’ was more conservative. This 90% figure is almost identical to that obtained by the IGD in its recent survey of major manufacturers. Curiously, however, the proportion of retailers and distribution contractors anticipating a growth in the cross-docking of frozen food was much lower, at 59%. As these are the companies which will have to implement it at RDC level, they will be more aware of the technical, operational and financial implications and this may explain their greater caution. Overall, however, there is a high level of agreement that the cross-docking of frozen food will become a reality. This will put suppliers under added pressure to shorten lead times, accelerate deliveries and improve reliability.

‘Pick-by-Store’

40% of the manufacturers consulted believe that quick-response will ultimately lead to them having to assume some responsibility for the store-picking function; 35% believe that they will not be asked to pick by store in the foreseeable future. Very few, however, believe that this will begin to happen within the next three years. There is a great deal of scepticism over whether retailers will demand this service and whether suppliers and their contractors will be able to provide it.

Store picking of a single firm’s product range would only be economically viable within current replenishment schedules for large manufacturers. Even where the volumes justified picking by store further back along the supply chain, retailers might not want it. The assembly of a single manufacturer’s products in a roll cage could, for example, increase in-store logistics costs because the products would not be stacked in the correct sequence for shelving in the shop. This is significant as one supermarket chain has calculated that half its supply chain costs are incurred between the back door of the shop and the shelf.
It would be easier to generate adequate ‘store-pick’ volumes at shared-user cold stores where several manufacturers’ products could be assembled. Picking by store could then be done simultaneously for several manufacturers. This, however, would mean the primary consolidation centre (PCC) assuming one of the core functions of the RDC. A large PCC might generate several roll cages per day for a particular shop, in which case it could be advantageous to bypass the RDC and deliver directly. Through time the role of the RDC might diminish.

The current generation of cold stores is not designed to handle case-level picking and would clearly be ill-equipped for ‘pick-by-store’. This would require a major investment in additional space, a reconfiguration of existing capacity, new handling and IT systems and more staff. There would be a danger of simply duplicating many of the facilities already available in RDC. This highlights the need for a broader assessment of the relative economics of order-picking at different levels of the supply chain, which takes full account of the related transport, warehousing and inventory costs. This would help to optimise the distribution of frozen food at a supply chain rather than individual company level.

6. CONCLUSION

The replenishment of supplies on a quick-response basis is gradually transforming retail logistics operations as it affects an ever-increasing range of products. In the frozen food sector it has presented manufacturers with a major logistical challenge, for several reasons:

- their distribution systems are highly capital- and energy-intensive
- the industry contains many small firms unable to provide frequent delivery in viably-sized loads
- high degree of product seasonality
- high level of promotional activity
- steep underlying growth in demand
- high rate of product proliferation

Despite the relatively high costs of temperature-controlled distribution, much frozen food is regarded as a low value commodity for which demand is highly price-sensitive. This puts firms across the supply chain under intense pressure to minimise costs and maintain margins.
The high levels of energy consumption and atmospheric emissions are also making this sector a focus for environmental initiatives.

There was unanimous agreement that the main driver of logistical change in this sector was the tight squeeze on inventory levels at retailers’ RDCs. The majority of the manufacturers participating in the survey believe that the recent trends of shortening order lead times and increasing frequency of delivery will continue for at least the next three years. Most of them also expect a significant proportion of frozen food to be cross-docked within this period. There was much more scepticism about manufacturers assuming responsibility for ‘picking-by-store’, partly because the retailers were unlikely to demand it, but also because the manufacturers themselves would be unable to provide it without major new investment in cold storage space and handling systems.

The survey revealed that many manufacturers were already having difficulty meeting retailers’ existing delivery specifications, a problem compounded by the inadequacy of reception facilities at many RDCs. There was little evidence of quick-response burdening manufacturers with greater inventory, as average stockturn rates appear to have been declining. It is possible, however, that in the absence of these quick-response pressures the manufacturers could have achieved greater reductions in stock cover. It was frequently claimed that the supermarket chains were cutting their distribution costs at the expense of wider supply chain efficiency. Some managers argued that, given the current physical constraints on the primary distribution of frozen food, quick-response was being pushed too far too fast, leaving the manufacturers to bear the additional cost.

The survey also revealed considerable dissatisfaction with the availability of cold storage capacity, outmoded materials handling systems in cold stores and a slow rate of technical innovation by logistics service firms. Quick-response has increased demand for third-party consolidation services both by retailers and manufacturers and this is likely to continue. Most manufacturers are satisfied with the standard of service they receive but many complain that LSPs are not sufficiently proactive and/or willing to invest in more modern facilities. The rates paid to service providers may need to rise, however, to give them the incentive to invest in new systems and to ensure that these systems earn an adequate rate of return.
Overall, the study highlights the need for a wider appraisal of the impact of quick-response pressures on the supply chain in terms of both cost and energy efficiency. Critical to such an appraisal would be changes in the relative importance and functionality of the RDC and primary distribution / consolidation centre and the ability of logistics service providers to reconcile the conflicting needs of frozen food manufacturers and their customers. Several other issues emerge from the research which also merit further investigation:

- How are the logistical roles of the manufacturer, retailer, wholesaler and service provider likely to change over the next few years?

- What would be the potential benefits of integrating the scheduling of internal cold store activities and external delivery operations?

- What standard measures of cost, service and energy efficiency should be developed for the cold chain, to facilitate benchmarking and provide yardsticks against which future improvements can be measured?

- How are load consolidation networks and related charging mechanisms likely to evolve?

This paper will hopefully stimulate discussion on these issues and raise awareness of the current logistical concerns of frozen food manufacturers, who now supply over 10% of all the food consumed in the UK.
References:


Appendix: Survey Details

A list of 392 frozen food manufacturers was compiled using two business directories, Dunn and Bradstreet, the KEY Compass index, and a marketing database, EMMA. From this a stratified random sample of 150 firms was drawn. A letter was sent to these firms inviting them to participate in a telephone survey, or in the case of the ten largest manufacturers, to discuss the various issues in a face-to-face interview. All the firms were contacted by telephone within two weeks of the letter being sent. Just over half the firms consulted expressed a willingness to take part, but in many cases it proved difficult to contact the appropriate person and arrange a convenient time for interview. Within the time available it only possible to interview managers in a total of 42 companies. Six of these interviews, with senior managers in major firms, involved meetings, the remainder were conducted over the telephone.

The final sample of participating firms was closely representative of the industry by product type (Table A1), though not by size of turnover It contained a preponderance of larger firms and relatively few small businesses (Table A2). While in terms of individual business units, the survey was not necessarily representative of the industry as a whole, the inclusion of most of the major manufacturers in the sector ensured that it covered a large proportion of all the frozen food distributed in the UK. It is estimated that sample firms accounted for 45-50% of total frozen food sales.

Table A1: Sample Composition by Product Type

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Product Description</th>
<th>Proportion of Total Market by Turnover</th>
<th>Proportion of Sample by Turnover</th>
<th>Proportion of Respondents by Turnover</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>mixed product lines</td>
<td>38 %</td>
<td>40 %</td>
<td>46 %</td>
</tr>
<tr>
<td>2</td>
<td>fruit &amp; vegetables</td>
<td>9 %</td>
<td>10 %</td>
<td>6 %</td>
</tr>
<tr>
<td>3</td>
<td>meat &amp; poultry</td>
<td>14 %</td>
<td>15 %</td>
<td>23 %</td>
</tr>
<tr>
<td>4</td>
<td>dairy &amp; sweets</td>
<td>10 %</td>
<td>10 %</td>
<td>4 %</td>
</tr>
<tr>
<td>5</td>
<td>fish</td>
<td>16 %</td>
<td>16 %</td>
<td>16 %</td>
</tr>
<tr>
<td>6</td>
<td>ready meals / bakeries / other</td>
<td>12 %</td>
<td>10 %</td>
<td>10 %</td>
</tr>
</tbody>
</table>

Table A2: Sample Composition by Annual Turnover

<table>
<thead>
<tr>
<th>Firms Turnover</th>
<th>Turnover Profile of All Firms</th>
<th>Turnover Profile of Sample Firms</th>
<th>Turnover Profile of Respondent Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>under 15 million</td>
<td>57 %</td>
<td>53 %</td>
<td>12 %</td>
</tr>
<tr>
<td>15 to 30 million</td>
<td>15 %</td>
<td>16 %</td>
<td>6 %</td>
</tr>
<tr>
<td>30 to 60 million</td>
<td>15 %</td>
<td>15 %</td>
<td>15 %</td>
</tr>
<tr>
<td>over 60 million</td>
<td>13 %</td>
<td>17 %</td>
<td>67 %</td>
</tr>
</tbody>
</table>
Firms in the sample operated a total of 104 factories and used 96 cold stores, 45% of which were run by outside contractors (Table A3). All but one of the manufacturers distributed their products throughout the UK. A quarter also exported a proportion of their output. Table A4 shows the breakdown of the sample firms’ annual sales to wholesalers and retailers. The supermarket chains were by far the largest customers, accounting on average for just over 60% of their total sales.

Table A4: Division of Sales between Marketing Channels

<table>
<thead>
<tr>
<th></th>
<th>share of total sales</th>
<th>average value of annual sales (£ M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>supermarket chains</td>
<td>61 %</td>
<td>18.1</td>
</tr>
<tr>
<td>wholesalers</td>
<td>30 %</td>
<td>8.9</td>
</tr>
<tr>
<td>independent retailers</td>
<td>6 %</td>
<td>1.9</td>
</tr>
<tr>
<td>direct to cater or other</td>
<td>3 %</td>
<td>7.5</td>
</tr>
<tr>
<td>manufacturers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>