Center City Goods Movement: An Aspect of Congestion

EDGAR M. HORWOOD,[1] Associate Professor, Department of Civil Engineering
University of Washington, Seattle

Central congestion in metropolitan areas has been the object of only a little systematized research. Most of the research efforts so far have been oriented toward measuring vehicle delay. Corrective measures to limit the time or locations of goods transfer, or to restrict specific classifications of trucks from entry to the city center, are usually attempts to alleviate the congestion without an understanding of the nature of goods movement in downtown areas. The counting of vehicles is insufficient to gain an understanding of what goods move where, when, and why, in a city's central core.

This paper summarizes research under the sponsorship of the Urban Traffic and Transportation Board of Philadelphia. It is an effort to examine the generative aspects of urban traffic.

The actual goods movement to and from central establishments is presented and related to the efficiency of central transport operations and the economics of goods consolidation.

● THIS PAPER summarizes a pilot study undertaken by the Urban Traffic and Transportation Board of the City of Philadelphia, under the direction of the author. The impetus for the study stems partly from local lay interest in alleviating the problems of city center congestion, and partly from the interest of the staff directors in the generative aspects of persons and vehicle movements (1, 2). By pilot study is meant a preliminary analysis of the subject by a professional observer in the transportation field, securing basic data as available, but without the use of a project organization and standard field enumeration procedures. Without any clue of past experience in urban goods movement analysis to serve as a point of departure it seemed appropriate to conduct this type of investigative study.

The subject of the study is center city goods movement, rather than congestion, although the matter of congestion is the backdrop before which goods movement is viewed. An understanding of goods movement itself is an understanding of certain aspects of congestion and therefore is basic to development of either physical plans or public policy towards minimizing transportation conflicts, consistent with the recognized goals of central activities.

One of the primary problems leading to this research project was and is the limitation of current traffic measuring procedures to give a meaningful evaluation of the goods movement aspect of central congestion.[2] Commercial vehicle counts, even seggregated by truck types, do not give an adequate clue as to the requirements for the use of trucks in the city center. Other data called for in origin-destination studies by the standard procedures of the Bureau of Public Roads include the industry and business served by the truck commodity carried. But this data obtained for commercial vehicles is rarely summarized and would not appear to give such a clue either. Any policy concerned with the restriction of commercial vehicle movements in the city center should certainly be based on an understanding of the requirements for vehicle use. This study, therefore, deals specifically with the needs for the movement of goods them-

[1] Formerly Transportation Planning Analyst, Urban Traffic and Transportation Board, City of Philadelphia, Pa.

[2] Some excellent procedures for analysis of the goods movement aspects of congestion were introduced by Goodwin (3), whose analysis was made from data collected by accompanying the truck driver. The gathering of this type of data, however, has not been done on any large-scale basis, probably because of the high cost of collection.

selves. The study of commodity flows is by no means a new idea, but this is the first attempt known by the author to apply this type of analysis to the city center.

NATURE OF CONGESTION

Because the subject of center city goods movement cannot be broached without involving the term "congestion," it is opportune to put forth a few observations on this word and its semantic interpretations. A standard dictionary definition of congestion is "the action of heaping together in a mass." Early meanings ascribed to the word, dating back 200 years, carry such associated adjectives as "unnatural," "overcrowded," and "morbid." When used by either the press or the transportation analyst, the term invariably has strong negative connotations as related to urban centers, and the spoken word usually involves disparaging tonal qualities as well.

If the current use of the word congestion is associated with an unnatural traffic situation or overcrowded city center, then what is a natural traffic situation and uncrowded city center? Part of the semantic problem would disappear if the word "concentration" were substituted for "congestion." The term "concentration," as used by students of urbanism, connotes something natural and desirable for the furtherance of commerce and culture.[3] Concentration certainly must pay off, otherwise New York City would not have experienced the addition of 40 million square feet of office space on Manhattan Island since World War II (5), superimposed on a piece of real estate already congested to the nth degree. It can be concluded that congestion is a price paid for the advantages of concentration by both private and public segments of the economy.

Certainly, congestion cannot be reduced below some residual level needed to sustain the concentration and centralization that are absolutely essential to the existence of downtown establishments. Central congestion is the friction of space which economists discuss, resulting from the equilibrium between transportation cost and rent, and it is virtually impossible to quantify in an absolute way.

Another word that could be elaborated on under this heading is "conflict." Used in a traffic engineering sense, a conflict is the intersection of two desire lines of travel, such as occurs at a grade intersection. It implies some probabilities that both objects of travel will desire to utilize the same space at the same time. When this probability rises to some significant value, a congested situation may be inferred. Along the line of this reasoning, anything which reduces this mathematical probability of dual occupancy of the same space would inhibit congestion. Thus, the consolidation of goods bound for central stores would be an anti-congestion factor, and the reduction of either pedestrians or passenger cars likewise. However, if pedestrian linkages between establishments are assumed to be a major desired function of the core of the city, it is not logical to think of pedestrian movements as a co-contributor to congestion.

There is growing evidence from the analytical studies of downtown business areas that the foot linkage between establishments is the transportation connection of greatest importance in the highly concentrated central core. At this scale of settlement the motor car, trolley bus, train, and subway are only useful in trips between the core and other functionally differentiated land use areas. They can carry people in and out of the city center, but have only a minor role in central activities themselves.

Under the circumstances, congestion cannot be discussed intelligently without assigning value priorities to the objects of transportation competing for the same space. The value scale may also change at different times of the day. For example, during the morning and evening rush pedestrian movement is usually negatively valued in reference to persons movement by vehicles, but the reverse is true during the business hours. The extent to which center city goods movement is a contributor to congestion, therefore, depends on an assumed frame of reference for the evaluation of congestion. In the Gruen plan for Fort Worth (6), for example, such value is placed on the importance of pedestrian movements in the city center that a single goods movement vehicle would contribute substantially to congestion. In fact, not only is goods movement

[3] In urban sociology, "concentration" is considered one of the five or six ecological processes, others being segregation, invasion, succession, and decentralization (4).

separated by a grade differential, but all vehicular movements are excluded from the walking area core in that plan. Perhaps a more convincing proof of the contribution of goods movement to congestion in a retail center is the costs to which developers have gone to construct grade separated goods movement corridors in the regional shopping centers constructed in the past few years.

AREA OF ANALYSIS

Delineation of the study area was facilitated by three previous major studies, as follows:

1. The Philadelphia-Camden Area Traffic Survey of 1947.
2. "Person-Trips to the Central City," published by the Philadelphia City Planning Commission in 1954.
3. The Philadelphia Central District Study, prepared by Alderson and Sessions for the Philadelphia City Planning Commission in 1950, one of the most detailed functional analyses of a city center yet conducted.

Philadelphia has a fairly well delineated central business district, bounded by rivers on the east and west sides, the link between the Schuylkill Expressway and the Delaware River Bridge on the north at Vine Street, and a quite abrupt functional change of land use in the solid brick row housing on the south. These general boundaries contain about two square miles of land given primarily to commercial activities.

Although it was recognized that there were circulation problems in almost all of the 400 or so blocks comprising the central business district as described above, one salient land use characteristic stood out above all others and served as the basis for delineating the specific study area. This factor was the extreme concentration of activity in 39 central blocks, referred to hereafter as the "core," as compared with remaining 82 percent of the area, henceforth called the "frame." Various terms have been used to describe the functionally different area surrounding the concentrated retail and office core of the city. These terms include "fringe," "transition zone," "perimeter," and "frame." The term "frame" is used in this study as being the most descriptive word. Its use is found in other sources; for example, the Cincinnati Central Business District Space Use Study (7).

The core includes 14 complete censuses of business enumeration districts, as presented in the specially rendered supplement to the 1948 Census of Business for Philadelphia. There was a substantial congruity between the 39 blocks previously referred to and the central traffic enumeration district of the Philadelphia-Camden Area Traffic Survey, No. 000, as well as with major functional areas of the Alderson and Sessions report.

Figure 1 shows scale relationships between the core and the frame, as well as between the central business district and the city as a whole. The extremely limited size of the central core is not typical of Philadelphia alone and is worthy of some further analysis. This phenomenon was probably first expounded on by Hoyt (8) in the early 1930's and lately by Rannells (2), and in the Murphy, Vance and Epstein central business district studies (9). Mumford has repeatedly discussed the city center in terms of a walking distance scale, and what has been true of cities since antiquity in terms of his analysis is proving equally valid for the mid-20th Century American city, in spite of both the decentralization of the past few decades and the development of

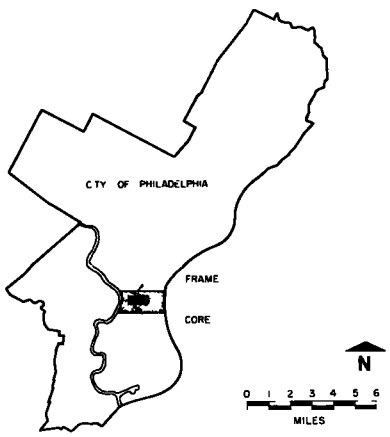

Figure 1. Size of the central business district.

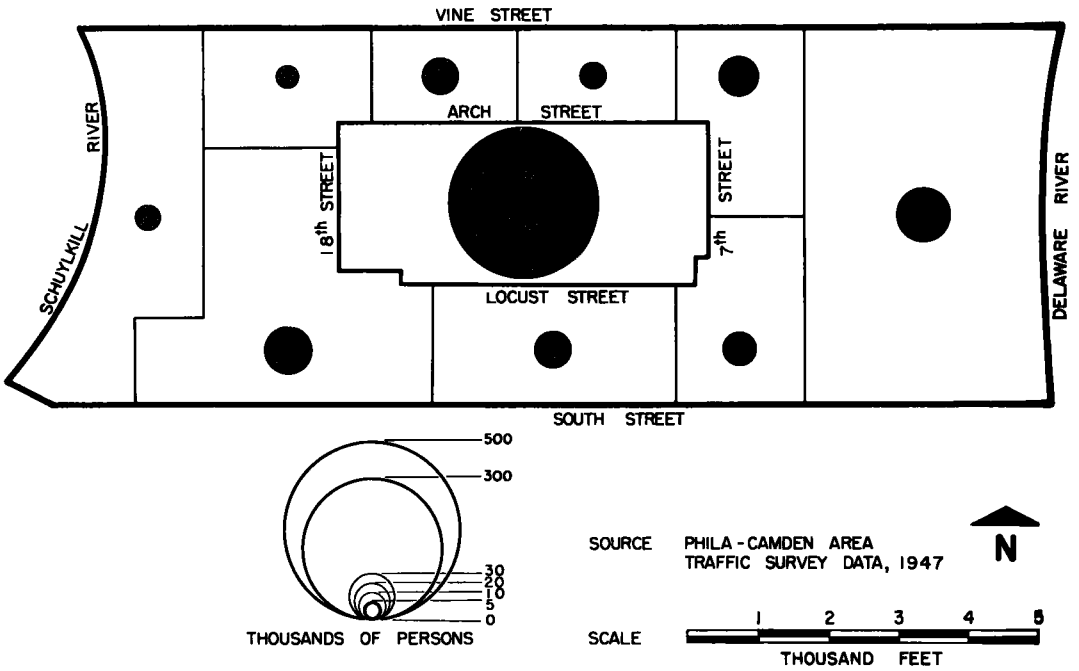

Figure 2. Number of persons entering central Philadelphia, by district of destination.

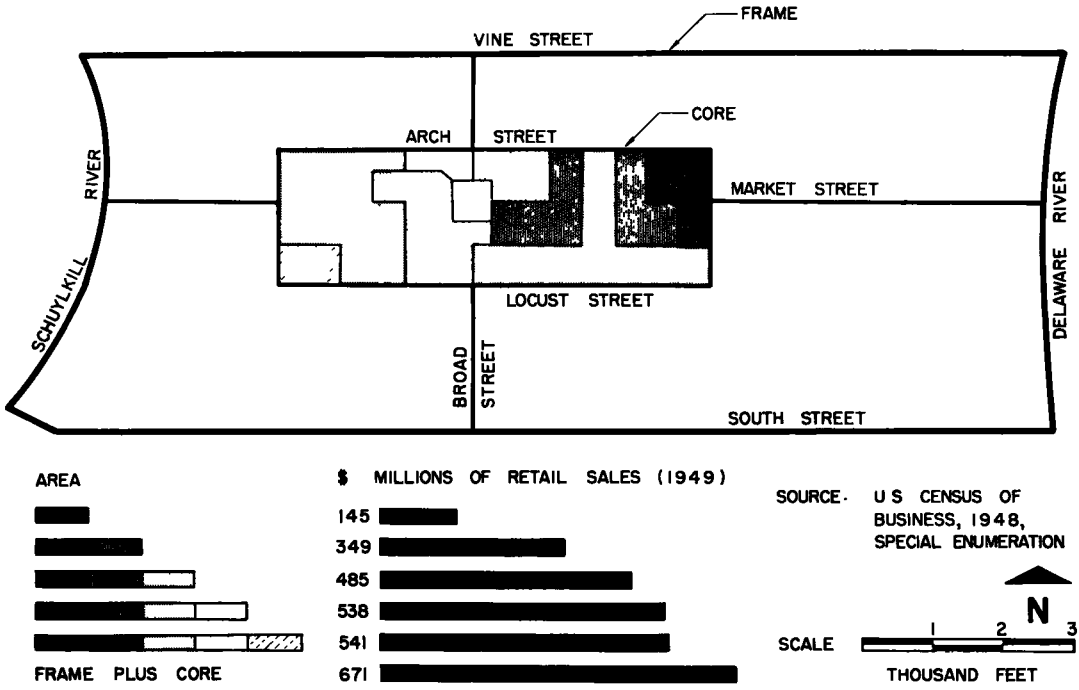

Figure 3. Retail sales productivity of the city center.

mechanized transport. In respect to ground space used for retail sales, consumer services, and general office functions, the core of Philadelphia, the hub of four million people, is only a little larger than the core of Emporia, Kansas, which has a service

area of less than 25,000 (10). The major difference in these contrasted cores is that of vertical scale.

Figures 2 and 3 show graphically some of the differential aspects of the core and frame; Figure 4 gives a breakdown of a range of selected indicators which further sharpen the focus on the core-frame concept. As a generalization, the core accounts for about 80 percent of central city activity in Philadelphia. Perhaps the importance of the core is unusually emphasized in this city, which developed an extensive rail and subway system when most western cities were still in the horse-and-buggy stage. Philadelphia entered the automobile age with a well-developed mass transportation system focused on the central business district. Nevertheless, the frame-core differentiation has almost universal validity in the analysis of not only the central business districts of cities, but also community and regional commercial centers as well.

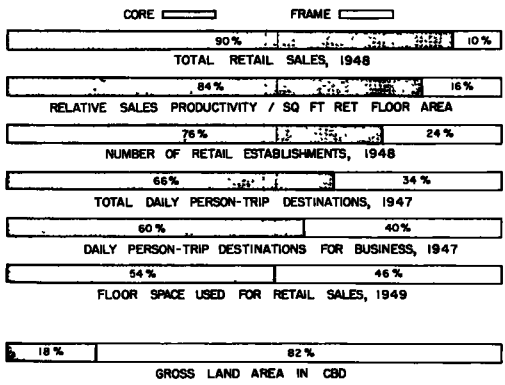

Figure 4. Core-frame contrasts, central Philadelphia.

The central core may be defined as an area in which business and service establishments are in close proximity to each other and linked by a walking distance scale of transportation. Within the confines of this area the main administrative and decision-making activities are carried on for the entire metropolitan complex. Even activities carried on in the outlying areas, such as the buying and selling of land or automobiles, require linkages (2) between core establishments, such as title and insurance companies and the municipal auditor. The core also contains a strong center of retail trade and consumer services and a high level residual market geared to the central business district labor force, in spite of the noticeable decentralization of a large segment of this activity. Although manufacturing, wholesaling with stocks, and some retailing and consumer services, are tending to leave the core, other uses requiring office floor space are increasing sufficiently to compensate for the loss. In effect, the cores of most large American cities are experiencing a change of life, but judging by the increase of floor space being added are emerging with a new strength.

Whereas the core is developed vertically in an intensive way, the frame customarily extends horizontally in an extensive way. The core rarely extends more than 2,000 or 3,000 ft in any lateral direction, but vehicular transportation is the rule in the frame, thus permitting unlimited distances on the basis of transportation, although limited by the market for the type of uses customarily found in the frame.

Establishments located in the frame have broadly varying characteristics, ranging from temporary, tax-paying uses (such as parking and used car lots) to functional groupings of concerns catering to the same need or furnishing the same product. The latter type usually includes automobile services, printing, wholesaling with stocks, and certain types of light manufacturing, just to mention a few typical ones. Structures in the frame, whether converted old dwellings or new functional buildings, are rarely more than two or three stories in height, even in medium to large cities.

Early observers in the field or urban ecology termed the frame a "zone of transition" (11) between the central core and close-in housing. It was recognized as the area of high land values and deteriorated dwellings because of centrality and imminent conversion to core uses. The core, it was thought, would gradually increase in size and expand into the next concentric ring. Actually, the functional difference between the core and frame was not recognized, nor was the limited lateral growth of the core anticipated.

The urban morphology discussed in the last few paragraphs can easily be recognized by viewing a city center from the air or studying oblique aerial photographs. Differences in the building scale between the two elements under discussion are quite

TABLE 1

RELATIVE ASPECTS OF CONGESTION

Item	Core	Frame
Major orientation of concern	Movement conflicts between vehicles and pedestrians	Movement conflicts between vehicles
Periodic flow of goods	Geared to retail trade	Geared to wholesaling, services, and manufacturing
Storage of cars	Disfunctional—uneconomic use of land	Functional—economic use of land
Relationship to a central highway distributor loop	Removed	Proximate or adjacent
Curb loading	Prevalent	Exceptional
Conflicts with surface transit	Major	Minor

apparent. Maps of building bulk, height, and floor-to-ground area ratio also disclose the same observation.

The importance of this immediate discussion to the general question of city center goods movement is that there is such a qualitative difference between the core and frame as to call for totally different approaches in the study of congestion, particularly the goods movement aspects of the problem. Some of these differences may be noted in Table 1; they have not been recognized in congestion and delay studies to date. The typical time and delay study, as a matter of fact, has tended to follow a route directly through the core (see 12, 13, 14), almost on the supposition that movement through the core of the central business district is a desired end. This type of study has only limited application to short-range benefits in the interim period awaiting the operation of freeway systems.

Under the manpower limitations of the current study it was decided to limit the goods movement study to the core, insofar as the most serious aspect of congestion exists there. Therefore, the study was constructed around the congestion problems of the core, which substantially influenced the type and range of data obtained.

GOODS MOVEMENT AND THE DEPARTMENT STORES

Five department stores in central Philadelphia account for well over one-half the retail sales of the core and close to 50 percent of the retail sales floor space. These five stores probably account for at least two-thirds and possibly three-quarters of the goods flow to the core. In addition to retail sales estimated from Bureau of the Census figures and previously mentioned, the central department stores receive and process most of the goods sold in their ten branches in the suburban areas. Furthermore, other retail establishments include mostly street-entrance specialty shops in which goods have a higher average value in terms of size than the average for department stores.

An analysis of goods flow to and from central department stores, therefore, is of paramount importance to an understanding of street congestion in the core of the city. This does not infer, however, that the department stores are responsible for a congested situation in proportion to the percentage of the central retail sales which they command. In fact, the reverse may be true because of the scale on which the department stores handle goods and the lack of any offstreet loading or receiving facilities for most of the street-level specialty shops.

The process of securing data on goods flow from department stores commenced with an interview at the top executive level, followed by conferences with the department head concerned with receiving and shipping, usually with the title of traffic manager. In most cases a certain amount of summary data was available, but because of the varying systems of record keeping an average of one week of contact time was required at each store to examine records, sample data, and develop coefficients for an interstore comparison.

The primary unit of goods movement is the "piece," which refers to a single package, carton, or bundled assembly of smaller elements. The bulk, size and weight of the piece is geared to both the human scale of handling and mechanical handling equipment. The average piece weighs 33 lb and changes little over the course of the year (see Fig. 10).

The processing and marking areas are invariably on the upper floors of a department store building, which have less productivity as retail sales space. If there is inadequate elevator capacity or magazine space on or near goods-receiving platforms, inefficiencies will result at the loading dock which will soon have repercussions on adjacent streets.

The mere examination of raw goods movement data can present a maze of facts, which, in and of themselves appear difficult to relate directly to the city center congestion problem. Goods arrive at department store docks via over-the-road trucks (termed motor freight), local vendors' equipment, local common and contract carriers, Railway and American Express trucks, mail trucks, and push carts. They may have been consolidated at the city of origin, points en route, or at the city of destination. Motorized equipment includes everything from semi-trailers to motorcycles. Goods leave the

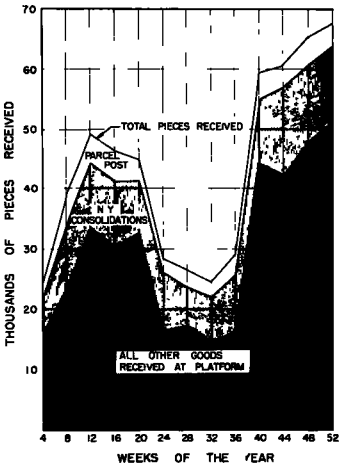

Figure 6. Seasonal variation in imports by mode of conveyance, Store No. 3.

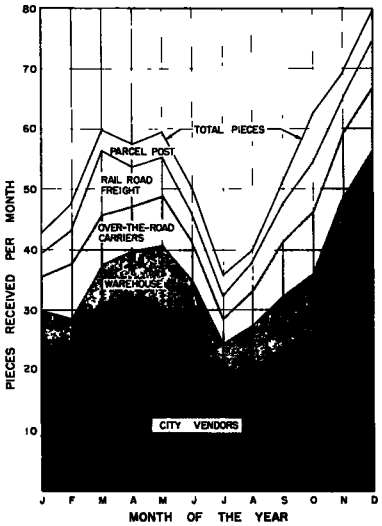

Figure 7. Seasonal variation in imports by mode of conveyance, Store No. 2 (1947).

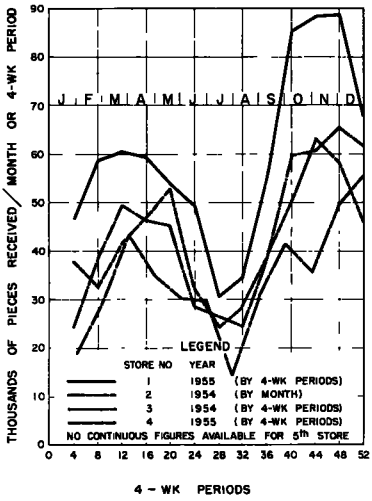

Figure 5. Department store imports, interstore comparison.

stores via United Parcel Service vehicles or some specialty hauling services, but a remarkably high percentage is carried out by patrons.

In terms of the financial responsibility for goods movement to retail outlets and looking toward consolidation implications, it appeared most significant to distinguish between goods originating inside or outside the metropolitan area. The term "metropolitan area" is used here not in the sense of a standard metropolitan area, as defined by the Bureau of the Census, but to connote an urban region within which common and contract carriers can operate without being franchised by the state public utility commission for intercity travel. This distinction further separates motor freight from what are termed "local deliveries," and is of practical importance because local deliveries are the financial responsibility of the vendors, whereas motor freight from outside the metropolitan area becomes intercity transportation and is paid for by the buyers of the goods. Here it is immediately evident that central stores will do everything possible to promote the consolidation of shipments from outside the range of local deliveries, in the interest of reduced freight costs, whereas they are not as much concerned with consolidation of local deliveries, for which they have no financial responsibility.

Figures 5 through 12 summarize goods movement volumes to and from the five central department stores. Each will be

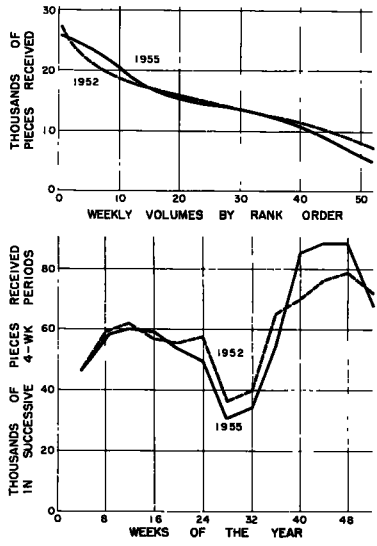

Figure 8. Deliveries to Store No. 1, 1952 and 1955.

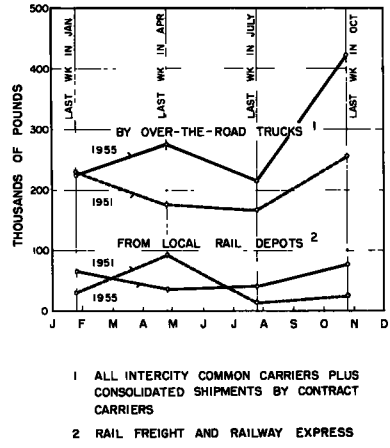

Figure 9. 1951-1955 rail-motor freight comparison, Store No. 1.

discussed in turn.

Figure 5 shows the generally similar characteristics of imports to all of the stores studied. The most significant observation is the extent of seasonal fluctuation. The average daily volume of goods handled in the last twelve weeks of the year is about twice the annual daily average, and the average daily volume in July and August is approximately one-half of the average annual daily figure; Figure 5 shows the extent to which buying habits are Christmas oriented. One important inference is related to the timing of traffic and congestion studies. Traffic counts taken in the midsummer period, for example, will not give a true picture of goods movement conditions for other seasons.

Figures 6 and 7 show seasonal variations in imports to department stores in central Philadelphia by modes of goods movement. With the exception of increased activity from the store's warehouse during the year-end rush, all modes fluctuate in a similar manner.

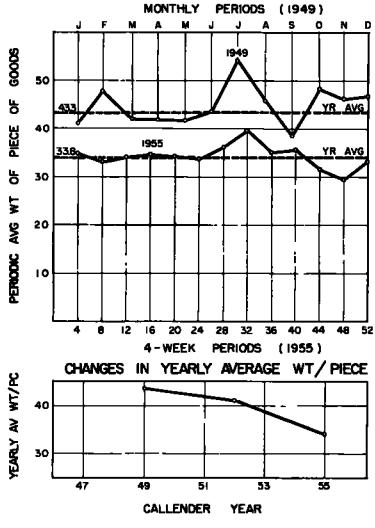

Figure 10. Changes in the average weight of pieces, Store No. 1.

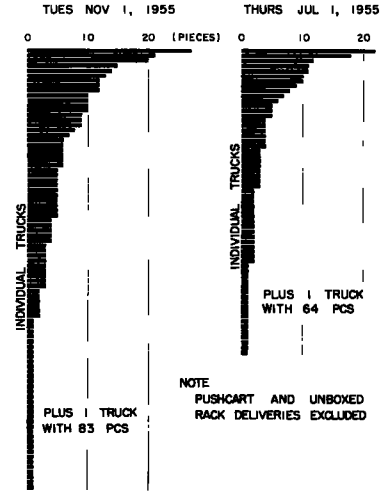

Figure 11. Deliveries from city vendors to Store No. 1.

Figure 8 shows the similarity in goods movement patterns from one year to another. This relationship implies the utility of expanding sample data to construct the goods movement volumes for the entire year. The rank ordering of weekly volumes discloses that about 40 percent of the annual volume is handled in the ten highest weeks, or 20 percent of the time. The ten highest weeks are usually in the fall of the year, although occasionally the Easter rush accounts for one or two weeks in the highest ten.

Figure 9 gives a hint as to changing trends between the use of trucks or rails for the shipment of goods from out-of-town vendors. From these data and the consensus of traffic managers rail movements have been stable over the last ten years, whereas trucks account for the increase in volumes where stores are experiencing a general increase in sales.

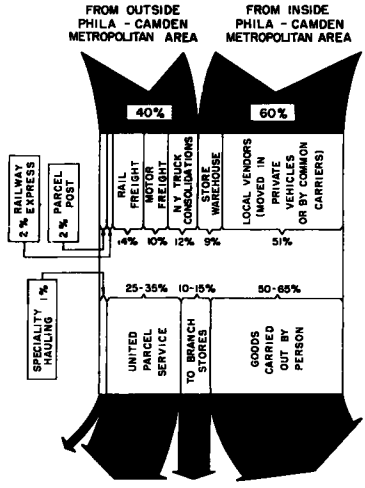

Figure 12. Goods flow diagram, five central Philadelphia department stores.

Figure 10 has already been referred to and is not discussed further.

Figure 11 gives a revealing picture of the spread in volume of goods delivered per truck. Although the movements shown are only for goods originating within the metropolitan area, well over one-half of all imports to the stores come from vendors' establishments within this area. The two days were selected at random as being representative of the summer low and autumn high volume periods. On the November 1 date, for example, the one truck with the greatest volume, 83 pieces, carried as many pieces as 40 vehicles. The meaning of this range is not entirely evident from the figures shown, however. Although a truck may have delivered only a single piece to the particular store, it may have been making series deliveries (see Fig. 13) to a number of establishments, thus representing an efficient operation as far as the use of street space is concerned. On the other hand, it may be that a 12- or 14-ft straight truck moves from a vendor's establishment to a central store and back, occupying 20 or 30 ft of lane space all the way, but carrying only one piece. Traffic managers interviewed indicated that both circumstances take place. To obtain a more accurate idea of the efficiency of truck movements from local vendors, therefore, it would be necessary to know the history of the total truck trip, including how many pieces were left where. The data presented in Figure 11 show the potential of investigating the efficiency of truck loading. The loading platform or curb stall is practically the only location at which the volume of truck contents can be examined, and perhaps a few questions asked of the driver. At best, only crude estimates could be made of the movement efficiency by platform examination; nevertheless, it is believed that such a platform study would materially further knowledge of center city congestion.

Figure 12 shows an estimate of total goods flow in and out of the central department stores. Goods entering from outside the metropolitan area by over-the-road trucks are separated into the two classifications of "motor freight" and "N. Y. consolidations," but the first classification also includes some consolidations from other cities or geographical areas. An estimated 15 or 20 percent of the deliveries from local vendors is consolidated to some extent by local common carriers who have consolidating platforms in the central area. Movements from outside the city represent a higher degree of consolidation, although they are concerned with a much smaller percentage of the goods than is received from local vendors. A surprisingly large percentage of the goods is carried out by customers, partially due to the efforts of the stores to reduce delivery costs by promoting a campaign that "The parcel you carry home gets there fastest." Goods movement to branch stores is handled by the United Parcel Service on

a contract basis, and represents a relatively efficient operation in terms of moving a large volume of goods per truck.

To summarize this section of the paper, three features of central city goods movement are emphasized, as follows:

1. The wide seasonal variation in central goods movement to department stores, which must apply to all other retail establishments, has important implications as far as the timing of traffic studies in the central area are concerned.
2. The greatest segment of goods movement to the core areas of large cities no doubt originates within the metropolitan area itself and does not pass through the hands of commercial truckers. This segment is most difficult to consolidate because of the short haul and dispersion of financial responsibility among thousands of vendors rather than a few principal stores.
3. The great number of trucks delivering only a few pieces each, and the space they occupy on the streets as well as at loading docks, gives rise to a serious consideration of the need for some system to reduce deliveries of one or two pieces. Conceivably this could be a consolidation scheme.

GOODS MOVEMENT AND THE SPECIALTY STORES

As a crude definition for the purposes of this study, all retail sales and service outlets situated in the core of Philadelphia other than the five major department stores are termed "specialty stores." In terms of total volume of goods received, some 3,000 of these establishments in the 39-block core account for considerably less goods movement than do the five department stores. However, because of the great number of loading locations the specialty stores no doubt contribute more to central congestion than do the department stores.

The task of studying specialty stores in relation to goods movement posed considerably more problems than the department stores. A few of these stores have their own loading platforms which do not infringe on street or alley space. Others have rear doors facing alleys, but no facilities for getting a vehicle out of the stream of traffic. Most depend on curb service at the front door, with goods received through the front door or via sidewalk elevators. Few of the specialty stores keep records of the number of pieces received each day.

The technique used to gather data on the specialty stores, as well as office buildings, was to select one of the 39 core blocks with a range of establishments and loading conditions which would typify the core itself. Accordingly, the block bounded by Chestnut, Market, Twelfth, and Thirteenth Streets was selected. This block contains more than 600 separate business establishments, 38 of which are street entrance retail sales or service outlets. The block has a working population of close to 10,000.

In the absence of a quantitative analysis of goods movement to the specialty stores a few findings are presented in descriptive form, particularly as they may relate to possible problems attendant upon municipal controls.

One large specialty store selling women's apparel receives more than 90 percent of its goods in daily consolidated shipments out of New York. It is part of a chain operation in which all of the buying is centralized. The goods are transported by handcarts from large over-the-road trucks at the curb to the front door of the store. The tractor-trailer combination arrives at eight each morning and occupies curb space for at least 30 minutes. This occurs coincidentally with the arrival of about 3,200 office workers to the same building in which the store occupies most of the ground floor. After unloading about 40 pieces each day the truck proceeds to other stores of the same chain outside of the central city. The restriction of over-the-road equipment from entering the central core would require transfer of the goods to the platform of a local carrier, with consequent cost and delay to the store. Delivery before rush hours, even with large equipment, might be more favorable to the store in contrast to a prohibition of tractor-trailers in the core, although it still involves extra man-hours and security problems. Here the goods movement aspect of congestion is seen in sharp focus. To what extent should the convenience of pedestrians take precedence over goods move-

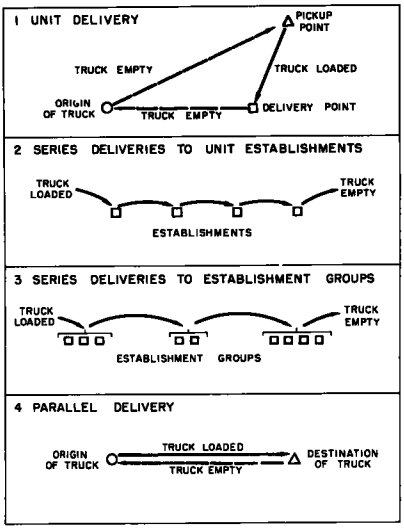

Figure 13. Modes of local goods delivery.

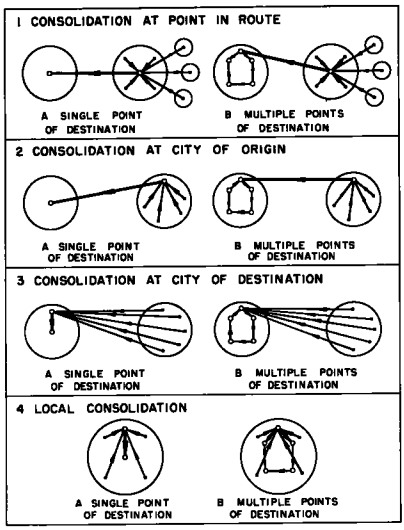

Figure 14. Modes of goods consolidation by truck.

ment, particularly if it adds to the cost of selling merchandise?

In contrast to the foregoing example, a men's apparel store in the same block receives about the same daily volume of goods in eight to twelve deliveries per day of four to six pieces each. Being unaffiliated with a chain, this establishment purchases from a variety of vendors. The goods arrive in a range of vehicles from station wagon to tractor-trailers, although straight trucks with 12- or 14-ft boxes predominate. This store likewise has no means of getting a vehicle off the street or alley for unloading. The prohibition of over-the-road equipment from entering the core would not materially affect deliveries to this store, yet this establishment with its ten or so deliveries daily, at any time, no doubt causes more street congestion than the women's apparel store discussed previously.

Street entrance establishments handling small items (such as jewelry, greeting cards, hosiery, ties) depend primarily on parcel post and railway express for deliveries. This form of delivery represents a form of consolidation (see Figs. 13 and 14). One or two short curb stops are made daily, usually during shopping hours. Unfortunately, this type of service makes almost continuous use of a traffic lane. Almost nothing can be done to advance or retard the hours of delivery to clear the working hours because of the necessity for person-to-person contact between the driver and merchant. Most of these establishments are small shops with only one or two people engaged in the operation. Whereas department stores can detail a crew and supervisor to man the loading platforms at six o'clock in the morning because of the staff flexibility with numbers, it would cause undue hardship for one-man operators to lengthen the working day by several hours.

Concerning the smaller retail establishments, some degree of street congestion arises out of the lack of inventory space. Many have no stock room space whatsoever, and must replenish supplies daily. In some cases the truck stands at the curb while the stock is surveyed and racks are restacked. This condition is also the nature of restaurants and food stores, and again is a type of delivery which is difficult to advance into the early hours of the morning or retard until the evening. This may be part of the cost which society pays for the preservation of the small, independent, decision-making unit of enterprise, which is important in the competitive system.

An important physical characteristic of specialty stores in most cities is the nature of the buildings which have them. They typically inhabit converted houses or older, commercially designed premises which have made no provision for goods handling other than alley doors or sidewalk elevators. More than likely, specialty shops are

in small, independently conceived buildings. In some instances the redevelopment of these sites provides integral goods movement planning for a range of establishments with street entrances. The very nature of both public and private redevelopment is that small sites are incorporated into larger ones. Consequently, this phase of the goods movement problem in the core of the city may gradually improve with time if loading space standards are established for new buildings.

GOODS MOVEMENT AND THE OFFICE BUILDINGS

The office buildings studied were those located in the typical block discussed in the previous section. A good range of sizes was included in this block, including buildings of 7, 12, 15, and 38 stories, respectively. The latter building is the tallest in Philadelphia, and typifies the goods movement problem arising out of tall central office buildings.

Goods movement to office buildings suggests classification under the two headings of building services and tenant services. The former includes washroom and cleaning supplies, garbage and rubbish removal, and building materials for redecorating and interior construction. The latter includes mail service, linen service, repairs to office machines, servicing of vending machines, delivery of bottled drinking water, deliveries (usually by United Parcel Service) of personal purchases by employees, deliveries of office supplies and interior furnishings, and moving service at the termination of leases. In addition to building and tenant services there are deliveries of commodities to tenants in accordance with the type of business activity engaged in. These may include samples or materials for sales or manufacturing, although the two items are not characteristic of central core establishments.

An interesting functional difference was noted for the four office buildings studied. The 38-story building, newest of the four, contained no tenants with more than a token requirement for goods deliveries other than for tenant services. No tenant in this building was engaged in either manufacturing or wholesaling with stocks, although this was not necessarily a restriction by the management.

In contrast to this building, constructed in 1932, the 7-story building was built in 1880 and contained mostly establishments requiring a significant amount of goods delivery. More than 80 percent of the floor space in the older building was devoted to furniture, shoe and book sales, with stocks on the premises. As a general rule, in the 39 core blocks the newer the building, the more its occupancy is confined to uses not associated with goods movement.

A strong parallel exists between the older buildings containing specialty stores and the older office buildings. Both represent a filtering down process in the use of space, which engenders goods movement problems. In the former case, the specialty shop may take over the old brownstone house, which was not designed to accommodate goods flow. In the latter, there is a technological obsolescence in space for office use in the older buildings, with some wholesaling or light manufacturing uses taking over the space as loft uses. In the natural redevelopment process new building floor space displaces these loft uses, which are generally forced out of the core or into its perimeter areas. It may be concluded, therefore, that some of the goods movement problems connected with the older downtown buildings gradually are diminishing over the long range, and attention should be focused on truck movements for building and tenant services to the principal office buildings in the central core.

Taking the 38-story Philadelphia Savings Fund Society Building as an example, the problem resolved itself to one of studying curb and loading space demand. As nearly as could be determined, tenant and building services in large office buildings require about one truck stop per day per establishment. With an assumed average curb time up to ten minutes, a structure the size of the PSFS Building would require enough loading space for four vehicles at all times during the day. Although built in 1932, this building has no offstreet loading space, and is dependent on a 70-ft curb loading zone. Building services alone average out to the continuous use of one curb stall.

Large buildings such as the PSFS Building in Philadelphia maintain a loading supervisor at the curb during working hours. These supervisors usually spend all their

time expediting turnover at the curb or loading dock, and in no cases determined in the study maintain records of deliveries. Strange to report, they are not authorized to receive goods for tenants, for subsequent internal delivery. No doubt this policy makes sense from the standpoint of the building management, but there are some rather interesting ramifications as far as use of the space at the curb or loading dock is concerned. For example, if a stenographer purchases a dress during the lunch hour and has it delivered by United Parcel Service in lieu of waiting for it to be wrapped, the UPS truck stops at the curb while the driver or messenger carrys the goods to some upper floor of the building for delivery to the specific office. This same process occurs in the case of Railway Express and American Express deliveries, the servicing of vending machines and water coolers, and in fact almost all tenant services. Under the circumstances most truck stops are well in excess of ten minures and a large number require several hours.

It is evident that building management policy can play an important role in reducing both the number of vehicles which arrive at the building and the length of time of each stop. No doubt such a policy has not evolved for very good reasons. For example, a lease requirement that tenants purchase equipment or supplies from specified vendors is probably distasteful to the lessee. However, more important than the duplication of companies supplying the same service, is the matter of internal deliveries. The abrogation of the right of the tenant to receive direct deliveries, other than mail, could be rescinded by lease agreement, or the lease could call for the tenant to designate the building management as the receiving agent for his deliveries. Such a policy, however unpopular with the tenants if generally installed throughout the core area, would reduce the demand for curb space of dock deliveries by at least one-half, according to several building managers interviewed. But, of course, a system of internal deliveries would cost a building management money, to the extent at least of an extra salary. And whereas a man could keep busy full time making internal deliveries to the tenants of a large building, this activity would be an inefficient use of time in a small building. Here, obviously, the social costs of congestion have to be weighed against both costs to the building management and some small inconvenience to the tenants. Nevertheless, it may be just as logical to legislate in the area of building management as it effects use of the loading spaces, as to legislate against the trucking industry concerning delivery hours or restrictions on vehicle movements.

Although the expediting of commercial vehicles at curb loading zones or offstreet loading docks will not reduce the number of truck stops, it will reduce the delay of waiting for a loading space by either double parking or milling around in the streets. A detailed study of truck stops for service or deliveries to large office buildings would be one of the more fruitful areas of congestion analysis, but was beyond the resources of this particular study. Unfortunately, all that can be reported here is from interview notes or limited periods of observation at the curb.

One method of analysis of downtown truck stops was made in the Philadelphia Central City Truck Survey of 1950 (15). In this survey observers circled each of the central blocks every half hour, recording the number of trucks parked, loading, and unloading. The data were rendered on a block basis, and also broken down according to a classification of light, medium, and heavy trucks. The license number of each truck was recorded, so that the same truck would not account for more than one stop, regardless of the number of times it was observed on the half-hour inspections. A correlation was later made by Mitchell and Rapkin (1) between the number of truck stops per block and the area of floor space devoted to the major nonresidential use, such as manufacturing, wholesaling with stocks, business services (general office uses) (1, 2).

Although these correlations point to the beginning of predictable relationships between land use and truck stops, somewhat more refinement is needed in the data collecting process before the Mitchell-Rapkin constructs will be as useful as they could be. For example, using the empirical relationship derived in their study, Store No. 1 would account for about 350 daily truck stops according to its floor area. Actually, on Nov. 1, 1955, one of the highest volume goods movement days of the year, only 125 trucks delivered goods to this store. A reverse situation was found to exist for office

buildings. Most of the discrepancy can be accounted for by the long interval between counts. By virtue of the half-hour count interval, at least as many vehicles escaped count as were counted. Most of the vehicles which escaped the screening made very short stops to specialty stores or office buildings, where only one or two pieces were delivered and the truck was away in a few minutes. In some cases, the lack of floor space for storage may account for a greater number of truck stops than if more inventory space were available. This is particularly true of small street level specialty shops.

Because of the growing importance of general office space in the core of cities, greater insight to central congestion may be gained by studying truck movements to office buildings. Such a study must be based on data collected by stationary observers at the curb or loading dock on at least a 12-hr basis. Data needed would include the type of truck by general size classification, length of time clocked at the loading zone, and the nature of the call; that is, pickup delivery or service. Detailed analysis of the nature of congestion will tell the extent of the need for exercising public controls over receiving procedures, and will also point out more specifically than the facts disclosed by this preliminary study the problems of such controls.

THE NATURE OF GOODS CONSOLIDATION

Goods consolidation is one of the most effective ways of reducing central business district congestion. The fewer the vehicles involved in goods movement, the fewer the conflicts between goods movement desire lines and the desire lines of persons movement, either pedestrian or vehicular. Practically all of the existing consolidation-oriented traffic studies deal with truck terminals (16). In addition, the need to group together establishments sharing common goods movement problems and requirements, such as commission houses (17), and the consolidation benefits of union truck terminals have been generally recognized (18). However, in a lengthy search no studies which link goods movement with vehicle movement, or which thoroughly examine the nature of consolidation, have been discovered.

To emphasize the importance of consolidation, a maximum of 40 to 60 trucks could supply Philadelphia's average daily goods requirements for all central district retail sales at currently demonstrated capacities to deliver goods. (These figures are based on a hypothecated consolidation service designed to divide the business between 12 companies operating four straight trucks each with established delivery routes. Actually, the five central department stores account for an average importation of less than 50,000 lb per work day and this could be handled easily by only six trucks.) Actually, the Philadelphia central department stores alone record about 500 truck stops daily during the heavy goods movement peak, and core retail sales in general account for at least 3,000 truck stops on the average day (15).

Goods consolidation is a natural economic development arising from the efforts of buyers of transportation services to save costs by avoiding less-than-truckload rates and minimum-cost charges. For large establishments with a high volume of goods intake, such as department stores, there are additional benefits from consolidation in reducing congestion at the receiving platforms and in minimizing the amount of paperwork connected with the receiving operation. Consolidation is also a natural economic development arising out of the efforts of the suppliers of transportation services to minimize the unit costs of shipments.

Barriers to consolidation include governmental regulations and operating rights, the capital costs of dock facilities for the "breakdown" of consignments, and the requirements of the buyer of transportation service for rapid delivery. In respect to the latter point, the buyers of transportation service usually have conflicting goals. They desire both the economies which consolidation has to offer and the special services which consolidation precludes.

Goods consolidation has both social benefits and social costs. On the benefit side it reduces congestion on the streets by minimizing the number of vehicles engaged in goods movement. On the other hand, under the complicated system of operating rights which has grown up in the separate states under public utility commission regulation,

many small commercial trucking concerns owe their existence to their franchises, and the promotion of large-scale consolidation by altering these rights would eliminate many independent trucking companies. Consequently, if the preservation of independent decision-making units of business is a desired social goal, any substantial reduction in the number of these units is an undesirable cost regardless of the congestion they cause.

The matter of regulation of trucking concerns has been preempted by state governments. The concept of the public interest, as far as operating rights are concerned, does not look into the problem of congestion. Municipalities are unaware of the granting of trucking rights. They receive no notice of the hearings, and the state public utility commissioners have no instructions in state legislation regarding their function to look into problems of the city streets. If, for example, only 20 companies were given the right to enter the core area of the city instead of 500, consolidation might increase ten- or twenty-fold.

In the process of this study an examination was made of several hundred of the more than 7,000 operating rights awarded to Philadelphia trucking concerns by the Pennsylvania Public Utilities Commission. These rights are jealously guarded and bitterly contested in tariff and franchise hearings, and account for many relatively empty trucks moving around the city center. Many truckers are franchised to carry only one or two commodities; others are restrictied in the size or weight of packages. In many instances the right relates to specific problems of specialty hauling, but in most cases they appear to represent merely a division of the total trucking business in such a way as to keep relative peace in the industry. In any event, state public utilities commissions are not concerned with the problems of congestion in their licensing policy; but if they were, considerably more consolidation might be effected. Is there any reason, for example, why more than 500 state-licensed commercial trucking companies should have a franchise to deliver goods to the core establishments of Philadelphia when 20 could easily service the area?

Along the lines of this reasoning an example may be taken from the municipal regulation of ambulances, tow trucks, and taxicabs. Although ambulances and two trucks do not contribute significantly to congestion, their freedom to operate in an unregulated way is recognized to be against the public interest by virtue of problems arising out of accidents. With taxis, however, there is a need to license arising out of a limited number of curb zones. The problem here is no different from that of the limited space in which to load or unload trucks either at the curb, in alleys, or in the limited docking areas sometimes provided by establishments.

The question of state or other regulation of operating franchises is a tangential one in this study, but this matter is felt to be one of great importance in working toward the reduction of central congestion. Not enough is known yet of the ramifications of this phase of the problem, and a sampling of a few hundred franchise rights is insufficient evidence on which to base recommendations for changes in public policy at the state legislative level. For this reason, further attempts to understand congestion should certainly involve a full-scale study of the effects of state regulation.

For the purpose of this study local goods delivery has also been institutionalized into four modes, shown diagrammatically in Figure 13. As in the case of the modes of consolidation, these modes of local delivery do not necessarily take place in pure form, but involve combinations of the four.

Unit delivery is the least efficient of all four modes because the truck is empty for more than one-half of its total trip. This mode does not constitute a consolidation. It is only relatively economical of street space when the truck is fully loaded, thus averaging less than a half-loaded condition for the total trip.

The series delivery to unit establishments is the usual type of delivery made by local haulers and carriers with fixed routes. The motion is relatively economical of street space, but has a high unit time of unloading per piece delivered because the unloading is not continuous. This mode of delivery may either consolidate the goods of one vendor to a number of establishments (as in the case of a milk route), or it may consolidate the goods from a number of vendors to a number of establishments (as in the case of a Railway Express Agency route).

In series deliveries to establishment groups the mode is similar to that just described, except that multiple deliveries are made at each vehicle stop. It occurs when the establishments to which goods are destined are clustered, as in the case of a parcel post delivery to various establishments in an office building. The prevalence of this type of delivery in the core of the city makes it difficult to relate truck stops to establishments of particular types, because one stop may serve many establishments. For this reason there are actually fewer stops to establishments of a given type in the central core than in the outlying areas of the city.

The term "parallel delivery" is given to the last mode because the desire lines of the outbound and return trips parallel each other. This mode occurs when goods move from a city vendor to a retail establishment in the vendor's equipment, with the empty truck returning to the point of origin. It does not represent consolidation because only one establishment is involved at the nodal points. The efficiency of the movements of this mode, in terms of the use of truck and street space, will vary directly with the degree to which the truck is loaded, but the truck will not average more than one-half a load.

As earlier data relating to the flow of goods to department stores indicate, some consolidation already takes place, particularly in intercity motor freight. Four separate modes of consolidation could also be distinguished (Fig. 14). Actually these modes are usually mixed and rarely take place in a pure form. Nevertheless, development of these basic modes aids in the discussion and interpretation of goods movement.

Consolidation at either the city of origin or points en route represents the greatest over-the-road economies. Under these modes of consolidation relatively full truckloads of goods are usually assembled in one city for destination to another, and sometimes even to a single store in the city of destination. In many instances this type of movement involves cartage agreements between intercity motor freight haulers and local trucking companies, although there is a tendency for large intercity truckers to do their own local delivery in smaller equipment than typical over-the-road trucks.

Consolidation at the city of destination represents the least economical mode by virtue of the need to accomodate several vehicles at the consolidating platform in the city of destination in place of one relatively fully loaded truck. In addition, several partially loaded vehicles may be used in the intercity phase of the trip, whereas one consolidated shipment would suffice.

In local consolidation city vendors and truckers carry goods to a common point for assembly and transfer to various central locations. As a city becomes large and consumes much of its own manufactures this type of consolidation becomes more desirable from the standpoint of reducing street congestion. Very little of this type of consolidation now takes place.

The subject of consolidation, like congestion, is difficult to discuss without the development of some constructs of vocabulary. This section has attempted to lay the foundation for analysis of consolidation by developing these ideas and terms. It has also presented certain insights into congestion not readily apparent from the examination of either the vehicle or goods movement in the problems of the fractionalization of goods movement rights under public utility franchises.

ECONOMICS OF MOTOR FREIGHT CONSOLIDATION TO CENTRAL DEPARTMENT STORES

As indicated early in the discussion of goods movement to the central department stores, a distinction must be made throughout the analysis between deliveries from vendors inside and outside the metropolitan complex. This distinction is based on financial responsibility for the cost of goods movement, type of equipment used, operating franchises, and other factors. It is also meaningful to carry this differentiation into the field of the economic analysis of goods consolidation.

First, the economics of local consolidation of inbound motor freight are considered. This represents the third mode of consolidation shown in Figure 14. The basis of this type of consolidation is reduction in costs of local delivery by transferring goods from large over-the-road trucks (usually tractor-trailer combinations) to smaller straight

trucks. The terms "motor freight," "motor truck freight," and "motor express" are used interchangeably by traffic managers to connote this mode of movement. The goods are carried in tractor-trailer combinations or large straight trucks, usually referred to as "over-the-road" or "line haul" equipment. Goods moved in this manner are generally purchased f.o.b. vendor's establishment or city of origin, and the cost of the delivery is borne by the buyer.

Because of the proximity to New York and the extent of goods supply from New York factories, the central Philadelphia department stores distinguish between motor freight which is consolidated in New York and that which comes from other cities, termed "New York consolidations" and "motor freight," respectively. Because the shipments from New York under this category are already consolidated for local delivery, the remaining market for local consolidation represents, at the most, about 10 percent of the total goods imports to Philadelphia department stores (see Fig. 12). Actually, some unknown amount of this 10 percent is consolidated in other cities of origin, such as Chicago and St. Louis, but only consolidations of motor freight from New York are segregated in the records.

On the basis of 1954 and 1955 data, the five major Philadelphia department stores receive about 3½ million pieces annually from all sources, or about 116,000,000 lb. At the most, 10 percent of this total weight represents motor freight that conceivably could be consolidated before it enters the central core of Philadelphia. Assuming that this 10 percent (11,600,000 lb) were gathered at one terminal outside the core for consolidated consignment to the five central stores, at a weekly assignment of 85,000 lb to a straight truck with a 12- or 14-ft box it would keep a daytime fleet of three trucks busy on an average annual basis. (These figures are based on estimates of trucking supervisors interviewed.) At a flat rate of $0.30 per 100 lb, this volume of freight would be worth not more than $35,000 annually to a consolidator. This estimate, however, is only a theoretically attainable figure, subject to limitations inherent in both seasonal fluctuations and the costs of goods breakdown for consolidation. (The $0.30 per 100 lb represents the maximum that local cartage managers believe could be established as a tariff for a central consolidation service. Some believe costs might run closer to $0.50 per 100 lb, at which rate the service would not be attractive to potential users.)

The seasonal fluctuation of deliveries to the stores under study has already been discussed (Figs. 5, 6, 7, and 8). Motor freight deliveries fluctuate in the same manner as the other categories of goods, with the summer low about one-half the average annual volume, and the fall high about twice that average figure. This variation indicates that for the foregoing example of consolidation, predicated on a relatively full utilization of truck space, it would require twice the average number of trucks to supply a consolidating operation during the fall goods movement peak. Although it is true that the downtown cartage companies do a larger business in the fall, the fact that they tend not to specialize in goods movement for retail trade alone tends to keep their load factors closer to the annual average than if they were exclusively in the business of central consolidation. Thus, if the central consolidation business must be predicated on a specialty service, as most of the truckers interviewed believe, the seasonal fluctuations noted will assume a greater role as a deterrent to successful operation than they would pose for trucking firms carrying a variety of goods.

As far as central goods consolidation is concerned, however, the important aspect of seasonal fluctuations is not the extra capacity of trucking equipment needed, but the possibility that a local consolidator may inherit primarily the peak season excess from the motor freight haulers. On an average, the central department stores receive 40 percent of their merchandise in the fall quarter of the year. Assuming that motor freight truckers now serving the central stores can economically handle a 20 percent overload based on the average annual rate, excesses above 20 percent overload occur only in 12 or 13 weeks of the year. If a local consolidator could funnel off only the excess volume above 20 percent overload, it would account for less than 50,000 pieces annually, or a dollar volume of about $8,000 worth of local cartage business for all Philadelphia central department stores.

It is readily apparent that the market for the local consolidation of Philadelphia-bound motor freight for reconsignment to the central department stores is quite limited. As long as over-the-road shipments can be brought into downtown stores without excessive delay for 39 weeks of the year there will be no strong desire on the part of intercity carriers to make a breakdown of the consignment at local terminals outside the core for subsequent delivery in smaller equipment, whether or not they use their own trucks for such deliveries.

If the local consolidation market for the reconsignment of inbound motor freight were broadened to include the specialty stores it is conceivable that the goods volume figures just mentioned would be increased by 60 or 70 percent, based on their share of retail sales and other factors. However, there are much higher costs in serving the many specialty stores as compared with the few department stores, so that the over-all outlook for an attractive local consolidation business is no better.

Still another factor inhibiting the entrance of locally-franchised truckers into the business of consolidating inbound motor freight is the fact that they are in competition in this respect with the motor freight carriers themselves. Most of the large intercity trucking organizations are also franchised by the respective states to deliver locally. Under the circumstances they break the consignment down at their own platforms for local delivery in their own straight trucks if it is uneconomical for them to take heavier equipment into the city center.

Thus far no mention has been made of the costs of a breakdown for local delivery in small trucks versus the cost of moving large trucking equipment into the congested core. These costs are best analysed by reference to the estimated cost-volume relationships shown in Figure 15. This figure gives an insight into the analysis which a motor freight carrier would have to undertake in order to arrive at a rational economic justification for the use of a local consolidation service, his own or otherwise.

Figure 15 shows the investment in transportation for any volume up to 100 pieces, and for two alternatives of delivery. The cost of one alternative is given by the line AB, and approximates the cost of delivering goods to a central store via tractor-trailer combination from some point on the regional highway system an hour's time-distance away from the store (including the delays in the core area and the cost of maneuvering at the store). The second alternative is given by the line A'C', and approximates the cost of delivering goods to a central store from the same point on the highway system, but via transfer of the goods at a consolidation platform for local delivery in smaller equipment. In the second alternative it is assumed that the consolidation terminal is half way, timewise, from the point of origin on the highway system to the central store. Thus, if 60 pieces are to be delivered, it will cost about $10.50 to transport them in the tractor-trailer, and $13.00 to transport them via reconsignment.

The other lines in Figure 15 show how these total costs were arrived at. The following assumptions were made:

1. The cost of operating a tractor-trailer combination is $8.00 per hour, including the cost of the driver and helper. (Determined from interviews with motor freight operators.)

2. The cost of unloading goods both at the consolidation platform and at the store is $0.12 per cwt ($0.04 per piece). (Determined from interviews with receiving personnel.)

3. Local cartage costs $0.30 per cwt, including both loading at the consolidation platform and unloading at the store. (Determined from interviews with local haulers.)

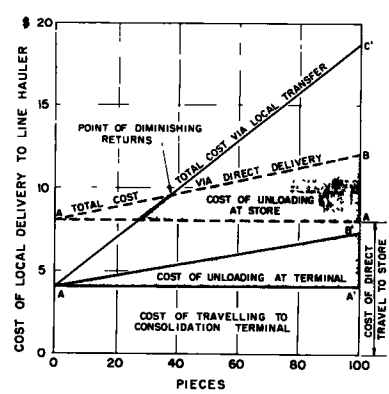

Figure 15. Cost variables in local delivery of motor freight (delivery by local carrier vs intercity carriers).

Returning to the example of a 60-piece delivery, the cost breakdown may be de-

TABLE 2

COST BREAKDOWN IN ALTERNATE MODES OF DELIVERY
(Example based on 60-piece load, see Fig. 15)

Distance Along Line Representing 60-Piece Load Ordinate	Cost Representation	Amount ($)	Total ($)
(a) Alternative 1—Direct Delivery			
Abscissa to line AA	Travel and maneuvering time to central store (1 hr)	8.00	-
Line AA to line AB	Unloading at store ($0.12 per cwt)[a]	2.50	10.50
(b) Alternative 2—Delivery via Local Transfer			
Abscissa to line A'A'	Travel and maneuvering time to consolidation terminal (½ hr)	4.00	-
Line A'A' to line A'B'	Unloading at terminal ($0.12 per cwt)[a]	2.50	
Line A'B' to line A'C'	Loading at terminal, delivery and unloading at store ($0.30 per cwt)[a]	6.50	13.00

[a] One piece is assumed to weigh 33 lb (see Fig. 10).

termined from Figure 15 by observing distances along the ordinate representing a 60-piece delivery (see Table 2).

The intersection between lines AB and A'C' in Figure 15 indicates, for the assumptions made, the point beyond which it does not pay a motor freight carrier to have the shipment transferred for local delivery. This point of diminishing returns occurs at about 40 pieces, or 1,300 lb. Many factors, of course, can alter the relationships shown. For example, a differential in the unloading facilities between the alternate possibilities will change the relative slopes of the lines AB and A'B'. More or less delay would alter the vertical position of the travel time lines AA and A'A'. A higher rate of local consolidation and cartage cost would alter the slope of the line A'C' also. Any or all of these factors may change the position of the point of diminishing returns in a horizontal sense, but it is doubtful if it would lie beyond 60 pieces or at less than 30.

The most significant aspect of the relationships shown in Figure 15 is the fact that, excluding the New York consolidated motor freight, well over one-half of the remaining motor freight bound for downtown department stores in Philadelphia is in shipments comprising more than 40 pieces. Figure 16, for example, shows that 60 percent of the motor freight arrived in shipments of more than 40 pieces each. These relatively large shipments may have represented consolidated shipments out of other cities than New York. The important conclusion, however, is that on the basis of the foregoing analysis it would not have paid for 86½ percent of the trucks bringing motor freight to the particular store to have used a local consolidation service. In other words, if the motor freight haulers have to pay the cost of goods shipment breakdown and subsequent local delivery it simply does not pay them to keep heavy equipment outside the center of the city in a majority of the cases. The foregoing quantitative analysis, although based on rough assumptions, has been corroborated in many interviews with both truck dispatchers and drivers.

As far as the interests of the department stores are concerned, the major advantage to the elimination of over-the-road equipment at their docking platforms is the expediting of the total receiving operation in terms of processing trucks themselves. However, in respect to expediting the flow of goods, a tractor-trailer combination well loaded with packages for the store is more desirable than many trucks delivering the same amount of goods. The offending vehicle to the department store, therefore, is the over-the-road truck which leaves only a few pieces at the establishment. Insofar as the stores pay the cost of motor freight, the question then arises whether they are willing to pay the extra cost of local consolidation, including a time delay in receiving goods. At present they will undertake this extra cost during only a few of the heaviest days of goods movement, when they cannot

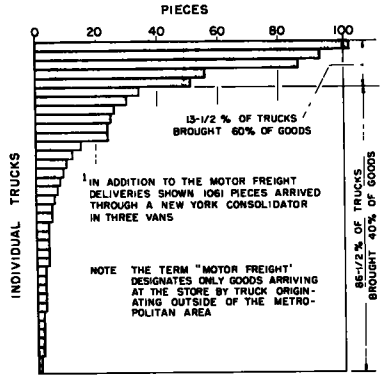

Figure 16. Motor freight deliveries to Store No. 1 on Tuesday, Nov. 1, 1955.

physically accommodate the flow of goods internally. Under these circumstances they call for some shipments to be delivered to the platforms of local carriers, for subsequent delivery to the store at their own cost.

The cost of eliminating a majority of the large motor freight trucks from the city center is actually quite nominal. Based on Figure 16, if the contents of the 32 vehicles delivering less than 40 pieces were handled through a consolidation service it would cost the store about $30, or a little less than $1 per truck. Vehicles delivering less than 20 pieces, however, could be accommodated in one shipment not exceeding the limits of a straight truck at a cost of $12, or $0.46 per truck, and vehicles delivering less than 6 pieces could be eliminated at the dock at a cost of $5.60, or $0.27 per truck. In the last instance, 20 trucks could have been eliminated, or about 16 percent of the daily figure.

CONSOLIDATION OF LOCAL DELIVERIES TO CENTRAL DEPARTMENT STORES

The terms "local deliveries" or "city deliveries" are generally used by store receiving-personnel to include goods which are delivered at the expense of and through means chosen by the vendor. Goods under this category almost always originate within the city or in the surrounding counties, and are brought to the central stores by local haulers or in the vendor's equipment, customarily straight or pickup trucks.

The department stores do not keep records of the delivery equipment or service used by local vendors. Store traffic managers estimate that between 70 and 80 percent of the merchandise from local vendors is carried by local haulers, and that fewer and fewer local vendors are retaining their own equipment for delivery. One local carrier estimates a vendor would have to deliver 85,000 lb per week to warrant owning or operating a straight truck.

As seen from Figure 12, about one-half of all the merchandise sold in the central Philadelphia department stores comes by local delivery from metropolitan area vendors. The gross local delivery volume is close to 1.75 million pieces annually, or about 60 million pounds. The cost of moving this volume at typical local tariff rates, excluding minimum charges, is between $200,000 and $300,000 yearly, and represents about 1½ to 2 percent of the retail sales value of the goods. This cost is borne by the vendor, whereas the cost of motor freight is borne by the stores.

Local vendors could readily deliver to designated points of consolidation, and perhaps save time as compared with direct delivery to the stores. However, it would be entirely unconventional, if not extremely difficult for central stores to assess the cost of the extra transfer against the vendor. If a store were to order its local vendors to deliver to a consolidating platform, it would, without doubt, have to undertake financial responsibility for the remainder of the goods trip. This undertaking would add from 1½ to 2 percent to the cost of the goods, a fairly significant amount in a center city non-expanding retail sales market.

Unilateral action by any one store to consolidate goods from local vendors at a designated platform would put it in a disadvantageous position in a highly competitive market. Obviously, there would be advantages to central stores if the number of lightly-loaded trucks leaving goods at their platforms could be reduced. Nevertheless, the problems of instituting the consolidation of local deliveries on either a modest or a grand scale are at once apparent, as far as action by the stores is concerned.

The cost relationships shown in Figure 15 for motor freight do not apply to the alternative facing local carriers in the consolidation of city deliveries because there are two major differences in local consolidation which favor direct delivery in lieu of consolidation, as follows:

1. Lack of need to change size of truck.
2. Competition among local carriers.

Unlike the motor freight commodities previously discussed, goods from local vendors are not initially carried in very large trucks that are uneconomical to operate on city streets. Cartage agreements between local truckers for the consolidation of local deliveries to downtown stores implies an agreement between two or more companies

which are competing for the same commodity. Each local hauler is interested in becoming the consolidating agent, rather than deferring to a competitor. Local haulers and motor freight carriers are, on the other hand, essentially non-competitive with each other, and little enough consolidation has taken place even among the latter groups.

The nature of local deliveries to a central department store is demonstrated by Figure 11, which shows a rank ordering of truck stops to one of the stores on two separate days (chosen to fall within the summer low and fall high periods of goods movement). Although the specific type of delivery equipment is not known, a general concept of efficiency of delivery may be obtained. The term "efficiency," as used here, means the load carried by a vehicle expressed as a percentage of the vehicle's load-carrying capacity, on a volume basis. An efficient delivery, therefore, would be one wherein the vehicle, regardless of type, is fully loaded spacewise.

In some cases goods were brought in by private cars or station wagon, where a few pieces represented 100 percent efficiency, but most of the goods arrived in straight trucks or pickups. In other instances trucks may have been on a regular delivery route, and although only a few pieces were discharged at a given store, the trucks may have been efficiently loaded.

For the two days analysed in Figure 11, the average load per vehicle was about 4½ pieces. The average load increased only 10 percent between the summer low and the fall high periods of goods movement. In contrast, the average load per vehicle arriving by motor freight was almost 18 pieces on Nov. 1, 1955 (excluding New York consolidations), or about four times the average load coming by local delivery.

The magnitude of local deliveries on the observed days for one department store indicates that the operation of one straight truck making deliveries twice daily from a consolidation depot could easily handle the daily volume. A fleet of five straight trucks, therefore, could furnish all central department stores with a consolidated delivery service twice daily, substituting two truck stops for an estimated 300 vehicle stops per day under present circumstances. (This is based on a delivery capacity of 85,000 lb per week for a straight truck.)

CONCLUSIONS

Although this research pertains mainly to goods movement in central Philadelphia, there should be significant implications for any large American city. A few inferences can be drawn relating to the more obvious generalizations, as follows:

1. The larger the city, or the greater its dominance of a region, the greater is the probability that it consumes more of its own manufactures. This no doubt increases the percentage of central core imports which come from local vendors and results in a small average delivery per truck or, conversely, a large number of trucks to supply central establishments.
2. Cities within the sphere of influence of large manufacturing centers, such as New York, Chicago, and Los Angeles, no doubt enjoy a relatively high degree of motor freight consolidation from these centers. In cities within the area of dominant centers the prohibition of large over-the-road vehicles from entering the core may defeat the effort to reduce congestion. In Philadelphia, for example, one van carrying consolidated shipments from New York often accounts for as much volume of goods as 50 or 60 trucks arriving throughout the day.
3. In any form of municipal regulation or public policy a differentiation must be made between the central core and its frame, based on the functional nature of each. In the absence of underground vehicular facilities in the core, vehicles engaged in goods movement or tenant and building services should be given priority over non-commercial vehicles engaged in persons movement, as a higher type of street use in terms of the function of the core. On the other hand, pedestrian movement in the core should be the least compromised. Parking garages, bus depots, post offices, and drive-in establishments should be either restricted from the core or permitted only at peripheral locations in the core.
4. The development of integrated community and regional shopping centers does not necessarily decrease goods movement requirements in the core, because of the

necessity for stores to centralize receiving and marking operations. Although large items of hard goods are not received centrally for branch stores, almost all soft goods sold in the suburban branches are processed at the main store. There is not the slightest indication that this procedure will be changed.

5. Until major redevelopment of city centers takes place, consolidation has most to offer toward alleviating the goods movement aspect of congestion; but because of the wide seasonal variations in goods movement and absence of incentive for stores and local vendors to absorb consolidation costs, further consolidation will probably not take place without governmental regulation.

6. The most fruitful area for reducing central congestion due to goods movement is in some form of municipal regulation controlling the conditions under which goods are received. This could take the following forms:

(a) Establishment of a core cordon and prohibition of entrance by tractor-trailers carrying less than a specified number of pieces (about 40), or weight (around 8,000 lb) of load, with exceptions for "balloon freight." Enforcement could be effected by sporadic inspections at unloading operations in the core area.

(b) Requiring that stores within the inner cordon use the services of a franchised local carrier for individual shipments under, say, 150 lb or 3 pieces. Enforcement could likewise be effected by core inspectors on foot. This would force consolidation by substituting local contract or common carriers for vendors' trucks. Pushcart deliveries could be excepted.

(c) Municipal leasing of certain curb or other locations to licensed carriers engaged in central consolidated deliveries. This would give a limited number of carriers a better opportunity to render an efficient service by having preferred bases of operations. There are ample existing precedents for the limiting of operators in other fields, such as towing, taxi, and ambulance services.

7. The elimination of further truck operating rights in the central core by the state public utility commission is one method of reducing the impact of consolidation on the local cartage industry. It is easier to deny a prospective right than rescind an existing one. These rights run with the individual, and are subject to cancellation when a business is sold. Because a local trucking service does not require a large amount of capital there is a relatively large turnover in businesses. Most public utility commissions have it within their discretionary power to deny applications for franchises subject to finding that the denial will promote the public interest. This procedure would require active participation of agents of the large cities in the public utility commission hearings relative to these franchises.

GLOSSARY OF TERMS

Central Business District (CBD)—That portion of the city center characterized by a wide range of commercial and industrial uses, as distinguished from areas of the city devoted essentially to residential or heavy industrial uses. (In Philadelphia the CBD is generally considered to include an area of about three sq mi and 400 blocks, bounded by the Delaware River on the east, the Schuylkill River on the west, Vine Street on the north, and South Street on the south.

Central Core—That portion of the CBD characterized by the most intense business and commercial activity. The core is based on a walking distance scale of transportation between establishments and is visibly different from the frame surrounding it by virtue of the bulk and height of the buildings. (For this study the core of Philadelphia is considered to include a 39-block area bounded by Arch St. on the north, Walnut St. on the south, 7th St. on the east, and 20th St. on the west.)

CBD Frame—That portion of the CBD characterized by extensive uses of land, such as parking lots and garages, automobile services, wholesaling with stocks, and certain types of light manufacturing. As distinguished from the core, the frame contains low buildings, converted dwellings, and open space in a transitional state.

City Vendors—Manufacturers or wholesalers whose establishments are within the metropolitan complex so that delivery charges are absorbed by the vendor, rather than charged to the central stores. City vendors who do not have their own delivery equip-

ment use the services of transporters who are franchised to operate either within the city or between the city and suburban communities. If goods are transported by a carrier licensed to carry intercity merchandise this connotes a scale characterized as motor freight.

City Deliveries (or Local Deliveries)—These deliveries emanate from local vendors; 80 percent are estimated to be carried by common or contract carriers.

Motor Freight Carriers—This term is used by traffic managers to mean intercity or interstate carriers, who generally do some consolidation at the city of origin or way points along the route. Motor freight equipment generally connotes tractor-trailer combinations or straight trucks above 14 ft in box length.

Motor Freight—Goods transported by motor freight carriers. Any goods arriving by truck whose transportation costs are borne by the retail establishment are classified as motor freight.

Piece—A single box or package or a group of small packages tied together for handling as a unit. The size and weight of "pieces" are geared to ease of handling by platform personnel, and average about 33 lb.

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