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Seventeenth Annual Meeting

Theme:
"Beyond The Bicentennial:
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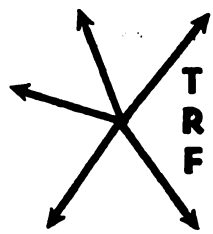

TRANSPORTATION RESEARCH FORUM

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THE DISTRIBUTION of freight in urban areas is characterized by high concentrations of truck activity in the relatively small areas of the urban central business districts (CBD). Freight distribution is typically performed by a large number of small carriers who duplicate each other's paths with partially-filled trucks while each is in the process of picking up and delivering a small number of very small shipments. As a result, urban freight distribution is responsible for a substantial share of the congestion, pollution, and energy consumption evidenced in the nation's urban areas, as well as the increased cost and reduced service provided to shippers and consignees.

While the current urban freight distribution structure is an enigma of our time, alternatives for easing the problems it creates have been identified. A series of recent studies and conferences on urban commodity flows identified the more prominent of these alternatives to be: temporal separation, spatial separation, required off-street loading/unloading, traffic engineering and consolidation terminals. Economically and socially, the consolidation terminal concept appears to be a promising alternative.[1] Several recent studies have shown that congestion, pollution and energy consumption can be greatly reduced by consolidating pick up and delivery operations within an urban area. Furthermore, these studies strongly indicate that substantial savings can be realized by sharply reducing the manpower and equipment expenditures required under the current system.

The major shortcoming of freight consolidation is that it suffers from institutional problems. First, there is currently an absence of coordinative mechanisms and regulatory procedures through which the consolidation concept can be planned and implemented. More importantly, freight consolidation is perceived by several special interest groups as a threat to their very existence. Consequently, a great deal of uncertainty exists as to whether or not organizations in urban goods distribution will cooperate to make the concept work.

STATEMENT OF THE PROBLEM

Government, academic and transportation industry leaders concerned about urban goods movement concluded at a recent workshop on Small Shipment Consolidation that the time has come to implement a consolidation terminal test program in a major urban area.[2] Such a program should be undertaken to examine the effects of consolidation upon freight distribution efficiency, pollution, congestion and fuel utilization. Also, an assessment should be made of the extent to which consolidation meets the economic needs of carriers, labor and customers (shippers and receivers). Before a consolidation program can be designed to meet the needs of each of these groups, however, planners must know something about those needs.

To obtain information about the needs of one of those groups, shippers across the U.S. were surveyed during the fall of 1975 to answer the following questions:

- Which carrier services are important to shippers?
- What levels of services do shippers currently receive from carriers?
- Are those service levels acceptable? In other words, are they consistent with what the shippers believe is reasonable to expect from carriers?
- Which carrier services would shippers most prefer to increase or at least remain the same and which would they be willing to sacrifice if a change in the system required it?

BACKGROUND OF THE SURVEY

In October, 1975, questionnaires were mailed to approximately 2,200 transportation managers in firms believed to engage in freight shipment activities.[3] Since the needs and concerns of shippers vary widely depending upon the type of goods shipped, company size, location, shipping destinations, consignee needs and many other factors, shippers cannot generalize and answer any questionnaire about an "average" type of shipment. To overcome this problem, each respondent was asked to indicate the types of shipments his company "most frequently sent out" considering what those shipments weigh, their destination, and the type of goods shipped. The shippers were asked to answer all remaining questions for those types of shipments.

Of the 2,200 questionnaires mailed, 402 usable questionnaires were returned. Certain characteristics of the respondents suggest that they are fairly representative of the general population of shippers. For example, for over fifty percent of the respondents, the largest number of their shipments are under 500 pounds. Shipments between 500 and 1,000 pounds account for the largest number of shipments of 10 percent of the respondents. For only 37 percent are the largest number of shipments over 1,000 pounds. These figures are fairly consistent with others' estimates that approximately 80 percent of all shipments handled by for-hire motor carriers are under 1,000 pounds.[4] The vast

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Shippers' Perceptions and Preferences for Motor Carrier Performance in Urban Areas: Implications for Consolidation Programs

by Robert A. Robicheaux and Ernest R. Cadotte***

majority (91 percent) of the respondents send the largest number of their shipments to destinations more than 100 miles outside of the city in which they are located. Only a very small group (3 percent) have their shipment destinations concentrated in the city in which they are located.

Although the managers who completed the questionnaires responded only for the types of shipments which they make most frequently, these kinds of shipments are very representative of all of their shipments. For example, nearly 80 percent of the respondents indicated that their largest number of shipments comprised over 75 percent of all of their shipments. Also, over 90 percent said that the service which they received from carriers for the rest of their shipments was at least as good or better than what they receive on their most common type of shipments.

FINDINGS

Preliminary analysis of the survey response data yielded information about the importance of various carrier services to shippers, the shippers' perceptions of actual and reasonable carrier service levels and the shippers' willingness to accept lower service levels in some areas to preserve or increase service levels in other areas. These findings are summarized below.

Important Services

In an earlier study, Saleh identified ten criteria which shippers most often use to select a motor carrier.[5] In this survey, shippers were asked to identify five criteria from that list of ten which are most important to them in their selection of a motor carrier. (See Table I) The five service criteria mentioned most frequently are:

- **Total Service Time**—Total pickup and delivery time in days to the destination of the largest number of their shipments.
- **Rate per Hundred Weight**—Shipping rate per hundred weight of their most frequent types of shipments.
- **Expediting**—The percent of their shipments on which the carrier is willing to expedite their shipment requests.
- **Shipment Tracing**—The percent of lost shipments on which the carrier performs successful shipment tracing.
- **Freight Loss**—The percent of loss and/or damage on their shipments.

IMPORTANCE RATINGS OF SERVICE CRITERIA

Rank Order of Service Criteria		Frequency of Mention in Top 5
1.	Total Service Time	277
2.	Rate per Hundred Weight	230
3.	Expediting	184
4.	Shipment Tracing	159
5.	Freight Loss	147
6.	Pickup Frequency	138
7.	Damage Claims Settlement Time	123
8.	Pickup Consistency	115
9.	Pickup Service Speed	97
10.	Special Equipment Availability	75

TABLE I

Noteworthy is the fact that the ranking of the importance of these five most important carrier selection criteria did not vary among shippers by number of shipments, size of shipment or shipper's location. Further, the high ranking of carrier expediting and shipment tracing services and freight loss records underscores the significance of these three variables for carrier marketing purposes. The implication of this finding for those considering the consolidation concept is that these five factors are important to almost all shippers. A consolidation program should not substantially reduce carrier performance in any of these critical areas.

Current and Reasonable Service Levels

Consolidation terminal programs will not be able to meet all service levels currently available to shippers. Where current services exceed shippers' expectations, however, a consolidation program could offer acceptable service levels to shippers and contribute to the

**Assistant Professor of Marketing and Transportation, The University of Tennessee, Knoxville, Tennessee 37916.*

***Assistant Professor of Marketing and Transportation, The University of Tennessee, Knoxville, Tennessee 37916.*

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alleviation of some of the goods movement related problems in urban areas. To identify opportunities for freight consolidation programs, measures were obtained of what shippers perceive to be current carrier service levels and what the shippers believe is reasonable to expect for their most common types of shipments. Attention was focused upon five particular service criteria.

1. **Pickup Service Speed.** After placing a call to a carrier to pick up a shipment, how many hours do you normally wait before the carrier actually picks up the shipment?

2. **Pickup Consistency.** The time between your request for a pickup by a carrier and the actual pickup may vary from shipment to shipment. In terms of the number of hours spent waiting for pickup, how much variation or "swing" around your requested pickup times do you experience in carrier pickup service?

3. **Pickup Frequency.** How many times per week do carriers stop to make pickups at this address?

4. **Total Service Time.** For the type of shipments which you make most frequently, how many days after you request pickup service does it take the carrier to make delivery to your customers?

5. **Carrier Profit Margin.** How much profit margin (ratio of profits to revenues) do you believe carriers make on your most frequent type of shipments?

The investigation was limited to these criteria because they relate to the major concerns of shippers that have been identified in earlier discussions of freight consolidation programs. Specifically, shippers have been concerned that consolidation would add to their platform handling costs; introduce additional delivery delays and increase the total service time to their customers; decrease the consistency of carrier pickup service; and/or, reduce the number of carrier pickups per week at their place of business.

Based upon their experience with freight forwarders, common motor carriers, shippers associations, and local and short-haul carriers, the shippers were asked to note the standard level of service which they receive from each of these carrier types and to estimate the profit margin earned by carriers on their shipments.

Their responses are summarized below and analyzed for differences by:

1. size of shippers' most frequent shipments
   a. small shippers (most shipments under 500 pounds)
   b. medium shippers (most shipments 500 to 1000 pounds)
   c. large shippers (most shipments over 1000 pounds)
2. location of shipper
   a. inside the city limits
   b. outside the city limits
3. number of shipments per week
   a. light shipper (fewer than 100)
   b. moderate shipper (100 to 300)
   c. heavy shipper (over 300)

Pickup Service Speed

After placing a call to a carrier to request pickup service, shippers naturally wait some time before the carrier actually makes the pickup. The largest number of respondents received pickup service within 4 hours after their request for service. (See Table II) Local and shirt-haul carriers tend to provide somewhat faster pickup service. This is due, of course, to the unique nature of their pickup and delivery routes.

The pickup service speed level considered reasonable by the shippers is consistent with the level provided by all four carrier types. The largest number of the respondents believe that 4 hour service is reasonable. (The mean of 8 hours is due to several extreme values.) What the shippers believe is reasonable varies significantly by the size of shipments but not by the shippers' location in the city or by the number of shipments made each week, how-

PICKUP SERVICE SPEED: PERCEIVED ACTUAL AND REASONABLE LEVELS

Pickup Service Speed	Freight Forwarders	Common Carriers	Shipper Associations	Local and Short-Haul Carriers	Reasonable Service Level
Mean (hours)	5.5	4.7	6.9	4.0	8
Mode (hours)	4.0	4.0	over 8	2.0	4
F-Value					
• Size of Shipments	0.8322	1.9249	1.1336	0.36499	9.6620[a]
• Location in City	0.3002	3.1209[c]	0.0793	0.9780	0.0099
• Number of Shipments	0.0089	0.9085	2.8929[c]	0.0421	0.3706

a = significant at .01
b = significant at .05
c = significant at .10

TABLE II

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PICKUP CONSISTENCY: PERCEIVED ACTUAL AND REASONABLE SERVICE LEVELS

Pickup Service Speed	Freight Forwarders	Common Carriers	Shipper Associations	Local and Short-Haul Carriers	Reasonable Service Level
Mean (hours)	4.1	3.6	4.5	2.5	4.6
Mode (hours)	2.0	2.0	1.0	1.0	2.0
F-Value					
• Size of Shipments	0.4451	3.3876[b]	0.2602	1.9558	1.5490
• Location in City	0.1499	0.3460	0.0280	0.0006	1.0518
• Number of Shipments	1.8788	0.1063	0.0299	0.7924	0.0070

a = significant at .01
b = significant at .05
c = significant at .10

TABLE III

ever. Shippers whose most frequent shipments were under 1,000 pounds consider pickup service within 6 to 6.5 hours after calling for service very reasonable. Shippers of larger shipments (over 1,000 pounds) on the other hand indicated that they would tolerate 10.5 to 11 hours (next day) service. For those considering consolidation terminal programs to meet the needs of the small shipper, this finding suggests that those shippers expect faster pickup service (same day) than do the large shippers.

Pickup Consistency

The time between a shipper's request for pickup service and the actual pickup usually varies from shipment to shipment. In other words, a carrier may promise pickup service at 3:00 p.m., but, the actual pickup may take place any time between 2:00 p.m. and 5:00 p.m. Thus, the variation or "swing" around the promised pickup time may vary up to 3 hours. The survey shows that all carriers provide quite consistent pickup service. For most, pickups are made within 2 hours of the pickup time promised. (See Table III)

The shippers generally consider a slightly lower level of consistency to be reasonable, however. While most carriers limit their "swing" time to less than 2 hours, the shippers consider 2 to 4 hours reasonable. The shippers' expectations of reasonable service consistency did not vary significantly by shipment size, shipper location, or number of shipments per week. Thus, to meet the needs of the majority of small shippers, a freight consolidation terminal would have to provide pickup service that was consistent within a range of 2 to 4 hours.

Pickup Frequency

The great majority of the shippers surveyed indicated that individual carriers make pickups at their locations about 5 times per week. (See Table IV) There was very little variation in the frequency of pickup service among carrier types. Also, 82 percent of the respondents noted that they consider 5 pickups per week reasonable and this did not vary by shipment size, shipper location or number of shipments per week. Therefore, a freight consolidation program would have to provide at least daily pickup service to shippers.

Total Service Time

The total amount of time that elapses between a shipper's request for pickup service and carrier delivery to that shipper's customer (the consignee) is a most critical aspect of carrier service.

PICKUP FREQUENCY: PERCEIVED ACTUAL AND REASONABLE SERVICE LEVELS

Pickup Service Speed	Freight Forwarders	Common Carriers	Shipper Associations	Local and Short-Haul Carriers	Reasonable Service Level
Mean (times per week)	4.1	5.6	4.0	5.1	5.0
Mode (times per week)	5.0	5.0	5.0	5.0	5.0
F-Value					
• Size of Shipments	3.7642[b]	1.7930	3.6110[b]	0.4095	0.1661
• Location in City	0.7155	0.1877	1.1816	0.0770	2.0288
• Number of Shipments	0.3647	7.9634[a]	0.6442	0.1912	1.6512

a = significant at .01
b = significant at .05
c = significant at .10

TABLE IV

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TOTAL SERVICE TIME PERCEIVED ACTUAL AND REASONABLE SERVICE LEVELS

Total Service Time	Freight Forwarders	Common Carriers	Shipper Associations	Local and Short-Haul Carriers	Reasonable Service Levels
Mean (days)	6.3	4.5	6.9	2.0	4.2
Mode (days)	over 8	4.5	9.0	1.0	4
F-Value					
• Size of Shipments	4.6479[a]	5.6273[a]	2.8684[c]	0.4165	15.1606[a]
• Location in City	0.0236	0.7899	0.0052	0.9393	3.5515[c]
• Number of Shipments	2.8782[c]	0.0667	2.1932	1.0797	2.1049

a = significant at .01
b = significant at .05
c = significant at .10

TABLE V

Shippers rated this criterion as the single most important variable which they consider when selecting a carrier to move their freight. Respondents noted wide variations in the total service time provided by freight forwarders, common carriers, shipper associations and local and short-haul carriers. (See Table V) Local and short-haul carriers provide the quickest service while freight forwarders and shipper associations provide slower service. These differences suggest that the different types of carriers do indeed serve market segments which have different total service time requirements.

The shipper's expectations of a reasonable total service time is distributed evenly between 2 to 5 days. Further analysis of this distribution indicates that what is considered reasonable varies significantly ($F = 15.16$, alpha = .01) by the shipper's most frequent shipment size. Specifically:

- large shippers (most shipments over 1,000 pounds) expect 3½ day service;
- medium shippers (most shipments 500 to 1,000 pounds) expect 4 day service; and,
- small shippers (most shipments under 500 pounds) are willing to tolerate 5 day service

What is considered a reasonable total service time also varies significantly by shipper location. Shippers located within the city limits expect 5 day service while those located outside the city expect 4 day service ($F = 3.55$, alpha = .10). Thus, to adequately meet the average demand of shippers of small shipments who are located within urban areas, a consolidation program should offer 5 day delivery service.

Carrier Profit Margin

A fifth dimension of carrier operations that was investigated was shippers' perceptions of carrier profit margins. The shippers believe that there is little variation in profit margins among freight forwarders, common carriers, shipper associations, and local and short-haul carriers. (See Table VI) Most shippers indicated that 6 to 10 percent of the carriers' revenues on their shipments are profits. The carriers also noted that a 6 to 10 percent profit margin is reasonable.

The shipper's perceptions of actual and reasonable profit margins did not vary significantly by shipment size, shipper location or number of shipments

CARRIER PROFIT MARGIN: PERCEIVED ACTUAL AND REASONABLE LEVELS

Carrier Profit Margin	Freight Forwarders	Common Carriers	Shipper Associations	Local and Short-Haul Carriers	Reasonable Service Levels
Mean (percent profits to revenues)	10.2	10.2	11.2	10.2	10.4
Mode (percent profits to revenues)	6 to 10	6 to 10	1 to 5	6 to 10	6 to 10
F-Value					
• Size of Shipments	0.0612	0.1555	0.5361	0.4232	0.9607
• Location in City	0.2125	0.3803	0.8545	0.0036	0.6200
• Number of Shipments	0.0991	0.0821	0.7794	0.7679	0.0201

a = significant at .01
b = significant at .05
c = significant at .10

TABLE VI

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per week. Indeed, shippers of small shipments (under 500 pounds) believe that on the average, carriers earn about 10 percent in profits on their shipments. This misconception suggests that the education of small shippers on the unprofitability of small shipments is appropriate for proponents of consolidation.

Shipper Tradeoff Preferences

A major purpose of this study was to identify which carrier services shippers most prefer to increase or at least remain the same and which they are willing to sacrifice if a change in the transportation system required it. It is quite probable that a consolidation terminal could provide some service levels that equal or even surpass the levels provided by the current freight distribution system. However, there are some service areas where consolidation terminals will fail to meet current industry levels. Developers of a consolidation terminal should be aware of the areas in which shippers would willingly accept lower service levels and those in which the shippers would demand current levels as minimum standards. With this information, resources could be allocated and marketing programs formulated to best serve the needs of small, medium or large or other segments of the shipping market.

To determine the shippers' willingness to trade off one service level for another, the shippers were presented with a series of tradeoff matrices. (See Example) In each matrix, two service criteria were matched. Different possible service levels were indicated for each service variable. The shippers were asked to rank the combinations of carrier services in terms of how well they met their most preferred service levels.

EXAMPLE:

PICKUP SERVICE SPEED

PICKUP SERVICE CONSISTENCY		SAME DAY PICKUP SERVICE	NEXT DAY PICKUP SERVICE
	ALWAYS ON TIME	1 CHOICE	2 CHOICE
	USUALLY ON TIME	3 CHOICE	4 CHOICE

For example, one shipper listed his preferences in the SPEED and CONSISTENCY tradeoff matrix. By placing a "1" in the left-top square of the matrix, he indicated that his first choice is for consistent (always on time), same day service. His second choice is for consistent, next day service. This shipper would rather give up speed than consistency. His preference is for consistency rather than speed. This shipper also indicated that his third choice is for the same day service which is usually on time. His fourth or least preferred choice is for next pickup service which is only usually on time.

Six matrices were presented in the survey. The respondents noted their preferences for:

- Faster Pickup Speed or Greater Pickup Consistency
- Lower Total Service Time or Greater Pickup Consistency
- Faster Pickup Speed or Lower Rates
- Lower Total Service Time or Lower Rates
- Faster Pickup Speed or Lower Total Service Time
- Lower Rates or Greater Pickup Consistency

The shippers' preferences are shown graphically in Figure 1. Clear preferences emerged in the preferences for lower rates over faster pickup speed, lower rates over lower total service time, lower total service time over faster pickup speed and greater pickup consistency over lower rates. These preferences did not vary significantly by the shippers' size of shipments or their location. The differences were significant among the infrequent, moderate and heavy shippers, however.

Approximately one-third of the respondents make under 100 shipments per week. Another one-third make 100 to 300 shipments and the final third make over 300 shipments each week. When these light, moderate and heavy shippers' preferences were analyzed separately, a consistent pattern emerged. (See Table VII) Light shippers (under 100 shipments per week) have unique tradeoff preferences. These shippers prefer:

1. faster pickup service to greater pickup consistency;
2. faster total service time to greater pickup consistency;
3. faster pickup service speed to lower rates;
4. faster total service time to lower rates; and,
5. greater pickup consistency to lower rates.

All of these are the opposite of the heavy shippers' preferences. These findings suggest that the infrequent shippers value carrier pickup service speed and total service time much more than do the more frequent shippers. These shippers would rather pay higher rates and accept more inconsistent service than sacrifice pickup service speed and total service time.

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SHIPPERS' SERVICE LEVEL TRADEOFF PREFERENCES

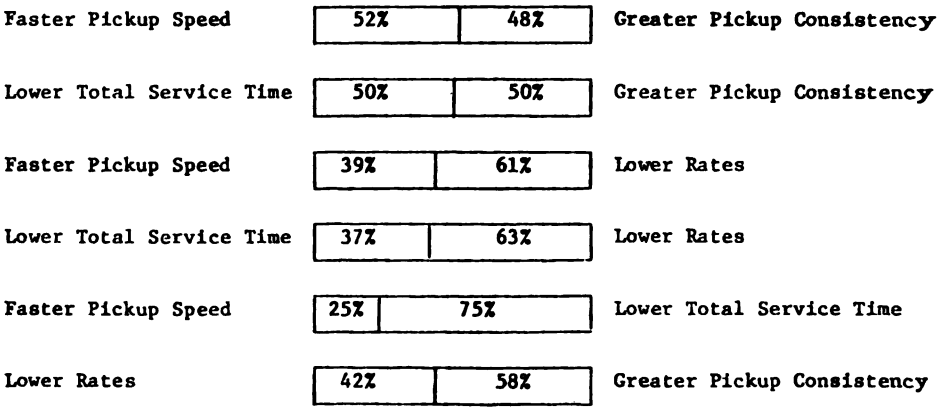

FIGURE 1

CONCLUSIONS

Based upon a recent survey of shippers, the following implications for future efforts to implement a freight consolidation terminal emerge.

1. All shippers, infrequent and frequent shippers of small and large shipments, are vitally concerned about total service time, shipping rates, the availability of expediting and shipment tracing services and freight loss ratios.

2. To meet the needs of small shippers (under 1,000 pounds) a consolidation terminal must provide for carrier pickup within 6 hours after the shipper's request for service.

3. All shippers, large as well as small, consider less consistent pickup service than is currently provided reasonable. A consolidation terminal must allow pickup service that is consistent within a range of 2 to 4 hours.

4. Consolidation must provide pickup service at least 5 times per week to most shippers.

5. Small shippers seem willing to accept slightly slower total service time than many carriers currently provide to them on their most frequent types of shipments.

6. Small shippers believe that carriers make as much on small shipments as they do on large shipments. Therefore, many probably underestimate the carriers' problems with small shipments.

7. Infrequent shippers (fewer than 100 shipments per week) value carrier pickup service speed and total service time much more than do the more frequent shippers (more than 300 shipments per week). The infrequent shippers seem to prefer to accept higher rates and more inconsistent service than to sacrifice pickup speed and total service time.

FOOTNOTES

1 See especially Irwin Blatner, **A Study of the Transportation Facilitation Center Concept**, Report No. DOT-OS-20224 (National Technical Information Service: Springfield, VA., 1974) and Robert A. Leighton and Robert T. Wood, "A Rational Urban Cartage System," **Transportation and Distribution Management** (October, 1971), pp. 15, 16, 18, 20.

2 This conclusion was reached at the Small Shipment Consolidation Workshop sponsored by the Federal Highway Administration, Federal Energy Administration and the Transportation Center at The University of Tennessee in Knoxville, Tennessee, January 13-14, 1976. Proceedings of that conference are forthcoming.

3 About 300 questionnaires were mailed to members of the Small Shippers Conference along with that organization's newsletter. The remaining 1,900 questionnaires were mailed to managers selected randomly from the 1974 Directory of Industrial Traffic Managers.

4 Blattner, **Ibid.**, p. 1.

5 Farouk A. Saleh, "An Empirical Examination of Industrial Buyer Behavior: A Motor Carrier Example," Unpublished Doctoral Dissertation, The Ohio State University: Ohio, 1970.

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SHIPPERS' TRADEOFF PREFERENCES BY NUMBER OF SHIPMENTS PER WEEK

Service Criteria	Total number of shipments per week			F-Value
	Fewer than 100	100 to 300	Over 300	
Faster Pickup Speed vs. Greater Pickup Consistency	Faster Speed	Faster Speed	Greater Consistency	4.0836[b]
Lower Total Service Time vs. Greater Pickup Consistency	Lower Time	Greater Consistency	Greater Consistency	0.8241
Faster Pickup Speed vs. Lower Rate	Faster Speed	Lower Rate	Lower Rate	2.7766[c]
Lower Total Service Time vs. Lower Rate	Lower Time	Lower Rate	Lower Rate	0.4215
Faster Pickup Speed vs. Lower Total Service Time	Lower Time	Lower Time	Lower Time	0.7693
Lower Rate vs. Greater Pickup Consistency	Greater Consistency	Lower Rate	Lower Rate	2.7857[c]

a = significant at .01
b = significant at .05
c = significant at .10

TABLE VII

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