**Developments in Business Simulation & Experiential Exercises, Volume 16, 1989**

# TRANSECON: AN INTERACTIVE PROGRAM FOR LEARNING TRANSPORTATION ECONOMICS

George C. Jackson, Wayne State University


## ABSTRACT

Transportation managers find themselves caught between the demand for smaller, time sensitive shipments and the increasing relative cost of smaller shipments. To help transportation and logistics students develop an appreciation for this dilemma and to teach them to develop strategies to deal with it, an interactive simulation called TRANSECON was developed. The following paper describes TRANSCON and how it can be used in the classroom.


## INTRODUCTION

A fundamental principal in transportation economics is to maximize the quantity of goods being moved at any one time so as to minimize the per unit costs of transportation.[1] This has always been an important objective of transportation managers. However, since deregulation of the transportation industry in the late 1970's and early 1980's it has become even more important because the spread between the costs of moving full volume loads and small, less-than-volume loads has widened.[2]

During the same period of time that transportation costs for smaller shipments have become relatively higher, there has been a definite trend toward smaller shipments as firms attempt to reduce inventories by implementing just-in-time (JIT) production and inventory systems.[3] In a JIT system, small, frequent deliveries of goods are made on an inflexible schedule. Thus, not only are small shipments required but there is no allowance or toleration for deviation from the prescribed delivery schedule.

The transportation manager is therefore caught between two opposing forces; the increasing relative cost of small shipments and the growing trend toward small, frequent deliveries on tight schedules. His or her problem is to keep transportation costs down and still meet increasingly stringent customer service requirements.

The primary transportation strategy for reducing transportation costs and improving customer service levels used by firms shipping less-than-full vehicle sized orders to customers is freight consolidation using pool distribution. In such systems, orders destined for the same geographic area are combined into volume shipments, transported to a central point in the market area where the volume load is broken down and each individual order is delivered. Transportation costs are reduced because the shipments are transported in volume from the origin to the market-centered breakbulk point. Service levels can be higher because transit times are shorter and more consistent for volume shipments than for less-than-volume shipments. Transit times could, however, be longer if the orders are held too long attempting to build a volume load. In the case of pool distribution there is a trade-off between transportation costs and customer service. The longer orders are held, the larger the volume shipment to a market area and the lower the per unit transportation costs will be, but the longer the orders are held, the slower the order cycle will be. In addition the relative attractiveness of a freight consolidation/pool strategy will be affected by the relative spread between the volume and less-than-volume freight costs, the size (weight) of orders and the volume of the orders in the system.

The task facing the teacher of transportation and logistics is to enhance the student's understanding of these relationships and to give them an appreciation of the transportation manager's alternatives. It was felt that an interactive program which could be used by the student on a PC would be an effective teaching tool in this situation. Unfortunately, there are no programs available which are easy to use and would provide the student with the experience of wrestling with the problems described above. The two programs that come the closest are PROLOG[4] and SIMCON[5]. PROLOG is an interactive logistics game which is very good for teaching the trade-offs between inventory, warehouse location, production scheduling, variable customer demand and transportation. Although PROLOG allows the student to consolidate shipments for stop-offs at different markets, consolidation through pools is not possible. In addition, time is not a factor in PROLOG therefore precluding measurements of the effects on service levels. The only model which captures the essence of the problem is SIMCON but it is a large-scale simulation model which is run on the mainframe and is not interactive.[5] SIMCON in this form is too large and awkward for students to use practically as a classroom exercise.

### The Model

The objective was to construct a model with the following characteristics:

- can be played on a PC by students on their own time;
- requires a minimal amount of instruction to use;
- is interactive;
- realistically models a freight consolidation/pool system.
- allows the student to experiment

The model, called TRANSECON, was constructed using the basic structure of SIMCON discussed earlier. A generalized flow chart of the model is presented in Figure 1. It is a downsized and somewhat simpler version of SIMCON. TRANSECON is an order by order, day-by-day simulation of a freight consolidation system. Each day is one pass through a large do-loop. It is written in Turbo Pascal, it is interactive, very easy to use, realistically models a freight consolidation/pool system and has a number of variables which can easily be manipulated by the user. The basic system which is simulated by TRANSECON consists of one manufacturing plant and finished goods warehouse located in Columbus, Ohio and twenty five major metropolitan areas where customers are located, Thus, orders are received in Columbus on a daily basis from customers in and around these twenty five major cities. Shipments are then made from Columbus to each customer. The user has the option of shipping each order direct to the customers the day following their receipt in Columbus or consolidating orders to each metropolitan area where they are subsequently broken down into individual shipments and delivered to each customer.

The user begins by specifying the number of days which will be simulated and whether to consolidate or ship direct. If the user chooses to consolidate the number of days orders can be held for consolidation, the level of transportation costs, the probability distribution of order sizes and the daily volume of orders must be specified. TRANSECON then generates the first day's orders.

Weights are assigned to each order using a random number generator and a user specified probability distribution of weights. Market areas are assigned to each order according to the relative population of each market. Each market, Its population and its cumulative probability distribution is presented in Table 1. Next, the orders are placed in files for each market/pool point. If the oldest order in the file has been there for the maximum number of days specified, the entire group of orders is shipped. Once shipped, transit times and freight costs are calculated for each order. Orders shipped and their attributes, such as freight cost and order cycle time, are filed. If the number of days to be simulated has been reached, summary statistics are calculated, otherwise another day is simulated. The summary statistics include, average freight costs per order, average order cycle time per order, the variance of order cycle time and the total weight shipped.

Using Transecon In The Classroom

TRANSECON is used in the classroom as a one-time assignment for the carrier management or traffic management sections of a transportation course or the transportation section of a logistics course. It is not a term-long assignment such as PROLOG in a logistics course or MARKETER and COMPETE in a marketing course. TRANSECON is played individually or in small groups by students. Students are given a diskette containing TRANSECON and a short assignment/manual - The assignment sheet/manual is presented in Appendix A. Students are given a week to complete the assignment.

The assignment consists of leading the student through a series of experiments so that he or she learns the relationships of the major variables in a consolidation system. For example, the student is asked to double the volume of orders being received by the company which will result in shorter order cycle times
and lower per order transportation costs. The student is also asked to lengthen the maximum holding time for orders which will lower per unit transportation costs and may shorten the order cycle. The assignment concludes by asking the student how they would minimize the average transportation costs per order and how they would structure the system to give them the fastest order cycle time. This relatively short assignment gives students the practical understanding of transportation economics which would not be possible through lectures and readings alone. In addition, they become acutely aware of transportation's relationship to marketing.

## CONCLUSION

TRANSECON is an effective exercise for teaching the principles of transportation economics in general and the management of freight consolidation in particular. It is far more effective than using a lecture/readings format only. It brings the subject to life and places the student in the position of a manager facing a real-life problem. It gives the student valuable experience and builds their confidence that they can handle the problems and tasks they will face in their career.

It has the added benefits of getting them to use the computer and it helps to familiarize them with the benefits of decision support systems and artificial intelligence.

From the instructor's point of view, TRANSECON is very easy to administer. The instructor must simply make the disk and manual available to the students, collect the assignments and grade them.

## REFERENCES

1. Fair, Marvin L. and Ernest W. Williams (1975), Economics of Transportation and Logistics, p. 335.

2. Stephenson, Frederick J. (1987) Transportation U.S.A., Addison- Wesley Publishing Co. Inc., pp. 88-100.

3. Achonberger, Richard J. (1982), Japanese Manufacturing Techniques, New York: The Free Press.

4. Gentry, James W., George C. Jackson and Fred W. Morgan (1987), "PROLOG: A Business Logistics Simulation Game," Proceedings of the 1987 Transportation and Logistics Educators Conference.

5. Jackson, George C. (1982), 'SIMCON I: A Computer-Based Simulation Model for Evaluating Physical Distribution Strategies Involving Order Consolidation," Developments in Business Simulation and Experimental Exercises, Vol. 9, pp. 121-125.

6. Smith, Jerald R. (1987), Marketer: A Simulation, Boston: Houghton Mifflin Co.

7. Faria, A. J., R. O. Nulsen Jr. and D. S. Roussos (1984), Compete: A Dynamic Marketing Simulation, 3rd edition, Plano, TX: Business Publications, Inc.

APPENDIX A

You are the manager of a transportation system which has as its origin a plant and finished goods warehouse in Columbus, Ohio. Your firm's customers are located in and around twenty-five major metropolitan areas in the U.S. Orders for your firm's products are received each day of the week in approximate proportion to the relative population of each metropolitan area. For example, if New York City accounts for ten percent of the population of the twenty five cities, there is a ten percent probability that any incoming order will be from a customer in or near the New York metropolitan area. Each city, its population and its proportion of the population is presented in Table 1. Your task is to ship these orders to customers in an efficient and timely manner.

Transportation costs are a fixed amount per mile. These trucks are owned by your firm and only transport freight for your firm and it will cost you about the same to send them out regardless of the quantity of freight loaded into them. You can either ship orders directly to each customer or you can consolidate the orders into truckload shipments to the metropolitan areas where they will be broken down into individual orders and peddled to each customer. There is a handling fee at these pool or breakbulk points. You are now ready to use TRANSECON.

Transecon Assignment

A. Booting up

1. Insert disk in drive A
2. Simultaneously hit Ctrl, Alt, Del.
3. TRANSECON will ask you the following questions. Give it the numbers which are underlined below:

   How many days should simulation run? 50
   How many orders generated each day? 200
   How many days between shipments? 3

B. Assignments

1. No consolidation:

   What are the average costs per order, average order cycle time and variance?

2. Consolidate:

   What are the average costs per order, average order cycle time and variance?

3. Explain why there is a difference in costs and order cycle times for 1 and 2 above.

4. Reduce holding time to one day. What happens to cost and service? Why?

5. Increase holding time to 6 days. What happens to cost and service? Why?

6. Increase holding time to 6 days. What happens to cost and service? Why?

7. Now quadruple the number of orders per day. What happens to cost and service? Why?

8. Now assume that you are the manager of this transportation system and you have been charged with minimizing order cycle time and variance. How will you structure your system?

9. Now assume that you are charged with minimizing transportation costs. What will your system look like?

TABLE 1
Cumulative Population Proportions of Market Areas

| Market | Cumulative Proportions |
|---|---|
| Atlanta | 0.0267 |
| Baltimore | 0.0512 |
| Boston | 0.0958 |
| Chicago | 0.1850 |
| Cleveland | 0.2162 |
| Dallas | 0.2541 |
| Denver | 0.2741 |
| Detroit | 0.3254 |
| Houston | 0.3655 |
| Miami | 0.3967 |
| Los Angeles | 0.5338 |
| Minneapolis | 0.5583 |
| New Orleans | 0.5728 |
| New York | 0.7701 |
| Philadelphia | 0.8346 |
| Pittsburgh | 0.8614 |
| St. Louis | 0.8882 |
| San Diego | 0.9116 |
| San Francisco | 0.9751 |
| Seattle | 1.0000 |

TABLE 2
Mileages From Columbus, Ohio to Each Market Area

| Market Area | Miles |
|---|---|
| Atlanta | 533 |
| Baltimore | 392 |
| Boston | 735 |
| Chicago | 308 |
| Cleveland | 139 |
| Dallas | 1028 |
| Denver | 1229 |
| Detroit | 192 |
| Houston | 1137 |
| Miami | 1160 |
| Los Angeles | 2244 |
| Minneapolis | 713 |
| New Orleans | 894 |
| New York | 542 |
| Philadelphia | 462 |
| Pittsburgh | 182 |
| St. Louis | 406 |
| San Diego | 2220 |
| San Francisco | 2423 |
| Seattle | 2321 |