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A MARKETING APPROACH UTILIZED IN THE DESIGNING OF A COMPUTER MODEL OF A RAIL PASSENGER TRANSPORTATION NETWORK

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ABSTRACT

A computer model of a rail passenger transportation network is presented. The model uses marketing information for its primary data base. The model develops a fast track route and a regular track route between terminal nodal metropolitan areas.

INTRODUCTION

During the decade of the 80's, the United States will have to better utilize existing intercity passenger transportation methods than we did during the previous decade of the 70's. "Congress had decided that America must have an alternative to the gas greedy automobile. That alternative is public transit---particularly fuel efficient rail transit---and the federal pursestrings are being loosened to pay for it." (2 p.17) Accordingly, the Urban Mass Transit Administration (UMTA) will be dispersing some $50 billion for capital development and research during the next ten years. (2 p.17) As for the energy efficiency of railroads versus other methods of transport, Table I purports this fact.

TABLE I

Propulsion energy required to move 200 commuters 10 miles in line-haul service

Type of vehicle	Passengers per vehicle	Number of vehicles	BTU* per passenger mile	Total BTU*
Heavy rail car	200	1	103	205,060
Heavy rail car	100	2	205	410,120
Transit bus	67	3	517	1,040,250
Transit bus	40	5	867	1,733,750
Vanpool	10	20	1,389	2,777,800
Vanpool	6	33	2,314	4,583,370
Carpool	4	50	2,224	4,484,000
Average automobile	1.3	154	6,898	13,810,720

*British thermal units

Source: American Public Transit Association, 1978-79. (1)

Knowing that rail is the most energy efficient method of passenger transportation, it is a logical objective to offer rail transportation to an optimum number of passengers. The purpose of this study, therefore, is to develop an initial framework of a computer model that would design a comprehensive rail passenger travel network in the Continental United States.

There are many varied reasons why people travel from one place to another, such as, buying, selling, recreation, informational pursuits, etc. In almost every case there will eventually be a transaction involving money. From this fact, a computer model will be developed emphasizing these transactions, in other words, a model with a marketing orientation.

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FIGURE I

"Cities Within 300 Miles of Metro Area A"

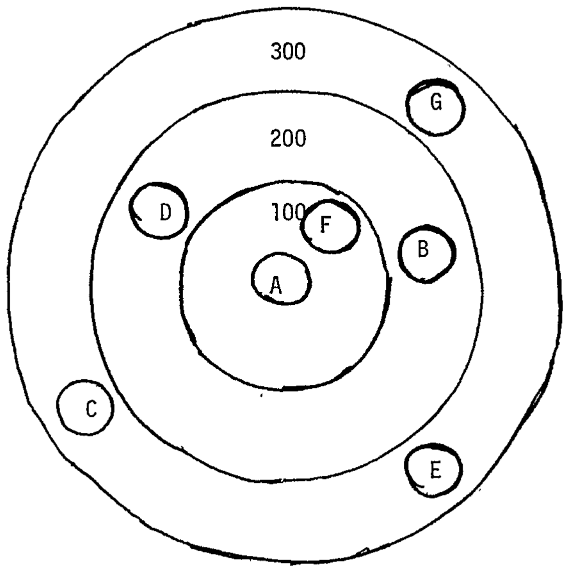


TABLE II

The Sixteen Largest Metro Areas Based on Potential (BPI) Interactive Occurences

Rank	Metro Area	Number of Metro Areas Within 300 Miles	PIO
1	New York	50	76832890
2	Philadelphia	55	48836966
3	Chicago	67	45354946
4	Washington	57	34457878
5	Detroit	53	30227846
6	Boston	37	28645331
7	Nassausuffolk	45	26469456
8	Newark	51	21718720
9	Baltimore	60	20750101
10	Pittsburg	62	18517248
11	Cleveland	61	15053368
12	Los Angeles	10	13144040
13	Buffalo	55	12654551
14	St. Louis	47	11104376
15	Rochester, N. Y.	52	10733400
16	Cincinnati	63	9916230

These sixteen metro areas become the terminal nodal points at the initiation of the model.

The model searches out other metro areas that are within 300 miles of each metro area. The distance of 300 miles was selected for use in this computer model because it is hypothesized that for many locations in the Continental United States this distance would be competitive with the speed of the airline industry for passenger travel. This is valid for three reasons. (1) Most of the top 300 metro areas do not have major airports in their immediate vicinity, so passengers must first drive to a major airport. For example, for many people residing in smaller midwestern cities, it would be quicker and cheaper to drive to a major airport, (eg. St. Louis, Chicago) Then to take off from The Local Tree Top Airlines. This additional traveling would result in extra travel time, perhaps between one and two hours. (2) Even if a metro area does have a major airpot, many of the flights from area to area are not direct flights. This means that many inter-city flights are routed through other airports, such as Chicago's O'Hara International Airport. (3) There are many delays in air transporation. For example, When there is bad weather, planes do not take off or land. Also when there is bad weather in Buffalo, (which could be your destination) the plane might have to land in Cleveland. The result is additional travel time. The final delay is queue related. This is the delay attributed to one unforeseen event at an airport. The result is the delay associated with planes being stacked over an airport waiting to

To develop a marketing oriented model, it is necessary to include in the data base the three marketing ingredients needed for a transaction, people, money, and a place for the transaction. (The proficiency for the place of the transaction can be measured by a metro area's ability to generate retail sales.) This study will use the Buying Power Index as its data base. The Buying Power Index (BPI) is developed from The Sales and Marketing Management Journal's,"Survey of Buying Power". This periodical is one of the most respected of all business periodicals for its accuracy, validity, and reliability. This source of data is used by all of the largest corporations when seeking information on the top 300 metro markets' population, income, and retail sales amounts.

Some of the terms used in the "Survey of Buying Power," should be clarified:

1. STANDARD METROPOLITAN STATISTICAL AREA (SMSA).

Revised criteria by the U.S. Office of Federal Statistical Policy and Standards (OFSPS) provide that an SMSA must include either (1) one city with a population of at least 50,000; or (2) one city with a population of at least 25,000, which, when combined with contiguous places having a density of 1,000 or more people per square mile, will have a population of at least 50,000 (provided that the city and contiguous places are in a county or counties with a population of at least 75,000). (3, p.A46)

2. EFFECTIVE BUYING INCOME (EBI).

A classification exclusively developed by Sales and Marketing Management, it is personal income less personal tax and nontax payments. Personal income is the aggregate of wages and salaries, other labor income (such as employer contributions to private pension funds), proprietors' income, rental income (which includes imputed rental income of owner-occupants of nonfarm dwellings), dividends paid by corporations, personal interest income from all sources, and transfer payments (such as pensions and welfare assistance). Deducted from this total are personal taxes (federal, state, and local), nontax payments (such as fines, fees, penalties), and personal contributions for social insurance. The resultant figures is commonly known as "disposable personal income." Market Statistics, the research division of Bill Communications that prepares the Survey data, removes from this figure compensation paid to military and diplomatic personnel stationed overseas to arrive at Effective Buying Income.

Effective Buying Income is a bulk measurement of market potential. It indicates the general ability to buy and is essential in comparing, selecting, and grouping markets on that basis. (3, p. A44)

3. BUYING POWER INDEX (BPI)

A weighted index that converts three basic elements--population, Effective Buying Income, and retail sales--into a measurement of a market's ability to buy, and expresses it as a percentage of the U.S. potential. It is calculated by giving a weight of 5 to the market's percent of U.S. Effective Buying Income, 3 to its percent of U.S. retail sales, and 2 to its percent of U.S. population. The total of those weighted percents is then divided by 10 to arrive at the BPI (3, p.A43)

Model

Each metro area's location was plotted using an X,Y axis system. Coordinates determine the relative position of the top three hundred metro areas in the Continental United States. The next step was to locate every city of the remaining 299 metro areas within 300 miles of each metro area. This is illustrated in Figure I.

The BPI for this study was then inputed into the model at three decimal places and multiplied times a thousand to eliminate non-integer values. Each metro area's BPI was then multiplied by every metro area's BPI within 300 miles.

Equation #1
$$\sum_{i=1}^{300} \sum_{k=1}^{N} M\,BPI_i * M\,BPI_k$$

where N=Number of Metro Areas within 300 miles

The result of these computations is the number of potential interactive occurrences (PIO) for each metro area within their surrounding 300 miles. The sixteen metro areas with the largest number of potential interactions is presented in table II.

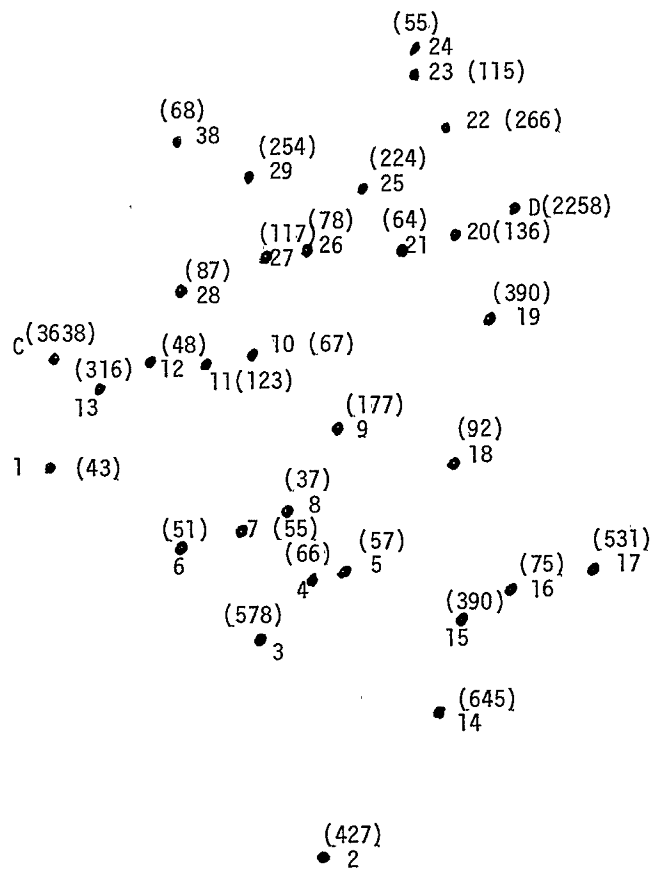
land. There is no corollary to transport with locomotives circling train terminals. For the above reasons, it is thought that for distances less than 300 miles, passenger train transportation could compete time-wise with the airline industry.

Two metro areas that are terminal nodes and within 300 miles are Chicago and Detroit. Referring back to Table II, it is noted that both of these metros have very large PIO's. For this reason, these two metros will serve as an example passenger train route.

The next phase of the model is to determine which metro areas might be potential route connectors between Chicago and Detroit. Figure II illustrates these metro areas. The numbers in the parenthesis are the actual BPI's for each Metro areas.

FIGURE II

POTENTIAL METRO AREA CONNECTORS BETWEEN
CHICAGO AND DETROIT



CODE:

C = Chicago
D = Detroit
1 = Kankakee
2 = Louisville
3 = Indianapolis
4 = Anderson
5 = Muncie
6 = Lafayette
7 = Kokomo
8 = Marion
9 = Ft. Wayne
10 = Elkhart
11 = South Bend
12 = Michigan City
13 = Gary
14 = Cincinnati
15 = Dayton
16 = Springfield
17 = Columbus
18 = Lima
19 = Toledo
20 = Annarbor
21 = Jackson
22 = Flint
23 = Saginaw
24 = Bay City
25 = Lansing
26 = Battlecreek
27 = Kalamazoo
28 = Benton Harbor
29 = Grand Rapids
30 = Muskegon

The model develops two separate route networks. The first network (Fast Track) will be a time-oriented system between metros, composed of very few stops. The essence of this system will be to link only the largest 100 metro areas, or 62.9073% of the total amount of actual BPI for the Continental States. The fast-track system will operate perhaps on a Monday, and Friday schedule.

The second network will be composed of all the top 300 metro areas, or 78.67% of the actual BPI amount. The tentative schedule will be for Saturday, Sunday, Tuesday, Wednesday, and Thursday.

Alternatives for the Regular Route between Chicago and Detroit are presented in Table III

TABLE III

A SAMPLE OF
REGULAR ROUTES BETWEEN CHICAGO AND DETROIT

Alternative	Routes													Interactive Ratio	Rank
A		11					27						20	3.38	10
B	12	11	10	9	19								20	4.97	7
C	12	11	10				27		26	25	22			5.24	4
D	12					28	27		26			21	20	4.30	8
E		11					27			25	22			6.51	1
F						28		29		25			20	5.94	2
G	12	11					27			25			20	4.98	6
H	12	11	10		19								20	5.02	5
I	12	11	10				27		26			21	20	4.16	9
J		11	10				27		26	25			20	5.43	3

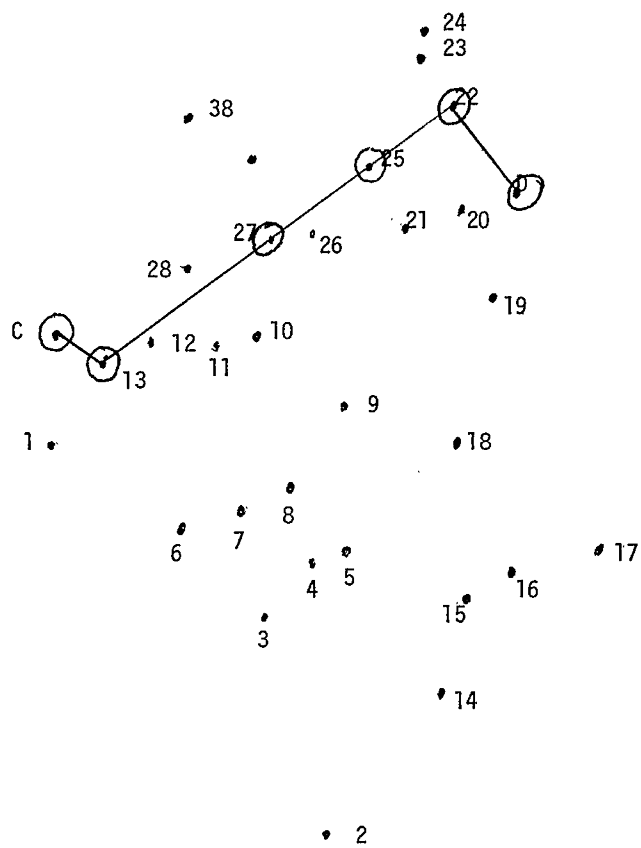
For illustrative purposes only ten alternatives are presented.

The interactive ratio is computed by dividing the incremental summation of the Buying Power Index for each metro area in the route, by the extra miles and stopping time for each additional metro above the near straight line route between the Chicago and Gary area to Detroit. The regular route selected is illustrated in Figure III.

It should be remembered that the fast track route considers only the largest 100 metro areas to be included in a network, or in other words, BPI's above the .1778% amount. Table IV presents some fast track routes and their relative ranked position. The route selected was not ranked in the first position, but was ranked number two. Examing the 29-25-22 route, it is almost an overlay of the regular route. It was decided to select a route that would benefit more metro areas with a rail passenger transportation service. Figure IV illustrates this route. Comparing Figure III to Figure IV, one is able to notice the added potential of the southern 9-19 route.

FIGURE III

Regular Route



Regular Route = C-13-11-27-25-22-D

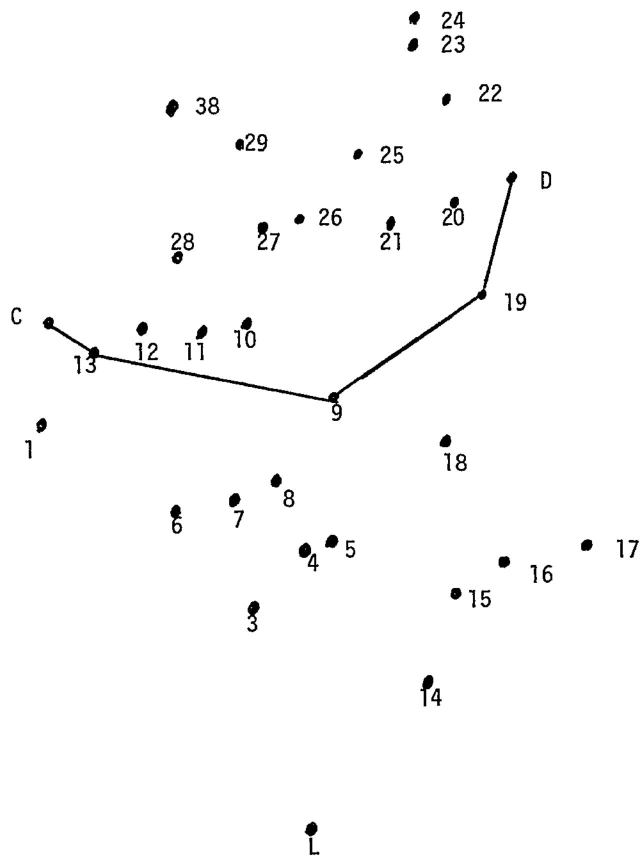
TABLE IV

A Sample of
Fast Track Routes Between Chicago and Detroit

Alternative						Interactive Ratio	Rank
A	9	19				5.61	2
B	9					2.32	10
C		19				5.40	3
D			29	25	22	5.72	1
E			29	25		5.03	5
F			29			4.95	6
G			29			3.17	9
H				25	22	5.32	4
I				25		4.00	7
J					22	3.50	8

FIGURE IV

Fast Track Route



Fast Track Route = C-13-9-19-D

DISCUSSION

The above paper has been a preliminary draft of a study to develop a computer model of a rail passenger transportation network. It is thought that this paper could be an initial pilot study for a more thorough work which would eventually develop a complete rail passenger transportation network for the entire continental United States. One of the primary objectives of this paper is to evoke discussions of the relative strengths and weaknesses of a proposed transportation model which uses as its data base, a buying power index.

REFERENCES

American Public Transit Association, 1978-79 edition of Transit Fact Book.

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