FEASIBILITY OF PRIVATE SECTOR HIGH-SPEED RAIL SERVICE IN THE DETROIT-CHICAGO CORRIDOR

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PREFACE

The material in this report represents the results of a preliminary examination of some of the major issues involved with private sector owned and operated high-speed rail service in the Detroit-Chicago corridor. Due to major adjustments in the scope of the project that occurred in the early stages of its execution, this inquiry was severely limited in regard to the detail in which some of the issues are examined. Those limitations notwithstanding, several important issues are addressed - in some instances the discussion is limited to the formulation of questions that should be explicitly addressed prior to endorsement of any service or system alternative.

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1.0 INTRODUCTION

High-speed rail passenger service is widely viewed as a technology and advanced mode of transportation "whose time has come." Based largely on the operating successes experienced abroad (in the United Kingdom (UK), France, and Japan), systems have been proposed in numerous corridors in the United States (US). Most advanced among these are those in Los Angeles-San Diego and Los Angeles-Las Vegas although studies elsewhere have been completed or are being proposed - e.g., Milwaukee-Chicago, Pittsburgh-Philadelphia, and in the states of Florida, Texas, and Ohio. Also spurring interest in this technology is the existing service in the Northeast Corridor and Canada although somewhat slower speeds are attained than that normally considered as "high-speed."

General characteristics that are descriptive of a competitive high-speed rail service include: relatively high operating speeds (i.e., 100-150 mph although the proposed Los Angeles-Las Vegas speeds are higher), large terminal cities spaced 300-500 miles apart, a high demand for travel between the terminal cities, and frequent service during prime traveling hours. These characteristics appear to be appropriate based on the experience abroad, and indeed, at least the demographic and demand characteristics are present in several US corridors. Given these criteria, it appears that the Detroit-Chicago corridor is a reasonable candidate to be considered for such service.

The primary purposes of the following discussion are the identification and examination of major issues concerning implementation and operation of high-speed rail service in the Detroit-Chicago corridor. Special attention is given to the possibility that such a service could be owned and operated within the private sector although some specific problems with such operation will not be explored. The latter include financing potential, transfer or use of right-of-way, political ramifications of technology selection, regulatory issues (e.g., conformance with environmental regulations), and direct or indirect government participation (e.g., loan guarantees). Rather, the privatization issue is outlined primarily in terms of the costs of implementation and operation vs. the revenue from operation.

The discussion herein primarily pertains to the Detroit-Chicago corridor per se although at various points in time and for some topics broader definitions of the corridor were considered - e.g., spurs to Lansing and Grand Rapids are discussed in the section on grade crossing protection.

There are then, four substantive tasks that are addressed:

- Task 1. Review/assessment of passenger demand;
- Task 2. Evaluation of grade crossing protection strategies and costs,
- Task 3. Survey of freight movement and development of a freight demand estimate, and
- Task 4. Cost and revenue estimates.

The presentation of a summary and conclusions considering these four points constitutes a fifth task.

2.0 REVIEW/ASSESSMENT OF PASSENGER DEMAND

One of the important elements in the analysis of the potential for high-speed rail service is the estimate of the passenger demand. Reasonably detailed demand estimates have been made for several of the proposed systems in the US (i.e., Ohio, LA-LV, LA-SD) and gross estimates have been made for others. None of the procedures for these estimates has been fully presented, documented, and discussed in public nor have the details of the methodologies been apparent. One of the most detailed demand estimates to date has been for the Detroit-Chicago corridor - funded by the Michigan Department of Transportation (MDOT) and developed by Transmark, a consulting firm affiliated with British Rail. Even so, there are several questions that remain unanswered in regard to that estimate.

The following discussion is concerned with that latter estimate and is directed to three areas: a recapitulation of Transmark's approach and their results, a discussion of the apparent assumptions and model structure employed by Transmark, and a comparison of the Detroit-Chicago estimate with projections and/or experience elsewhere.

2.1 DETROIT-CHICAGO PATRONAGE ESTIMATE: GENERAL APPROACH AND RESULTS

The basic goal of the Transmark study was to estimate patronage for 1985 and 2010 based on the proposed service (e.g., speed and frequency of service) that might be offered. The final estimates were based on three different speed/frequency (service) alternatives - 79/3, 110/6, and 150/12 (e.g., top speed = 79 mph and round-trip frequency per day = 3) - and are summarized in Table 2.1.

TABLE 2.1. DEMAND ESTIMATES FOR DETROIT-CHICAGO

	1985		2010	
	Passenger-Miles (000,000)	Rail Trips (000)	Passenger-Miles (000,000)	Rail Trips (000)
Do-nothing	81.5	487.6	96.6	696.6
79/3	114.1	757.4	--	--
110/6	214.9	1,575.9	299.9	2,597.0
150/12	319.9	2,623.2	468.6	4,309.4

Source: Transmark, 1981.

In many demand estimation procedures, a model is calibrated on existing behavior and trends in ridership and extended (extrapolated) to account for some system improvement or alternative mode in the future. (A regression based direct-demand model incorporating travel time and frequency would be an example.) Such an estimate for future ridership can also be tempered by considering comparable experiences elsewhere. The fundamental problems with developing a patronage estimate for high-speed rail passenger service in the US are that the mode is significantly different than its competitors and no comparable experience exists (in the US) with which to temper the estimate.

In order to overcome the problems presented above, Transmark utilized their own "Signals" modelling system which "incorporates an attitudinal sub-model based on trade-off analysis," which in turn is based on an "integration of methods developed in mathematical psychology and conventional transport modelling." In short, the Transmark estimate was based on individual (disaggregate) responses to hypothetical trade-offs in fare, service frequency, and travel time - thereby attempting to skirt the new mode-rail image problems that would have been confronted if a more traditional approach had been taken.

Other results of the Transmark study included: there is a greater sensitivity to speed (travel time) than to frequency differentials; new travel would account for approximately 15% of the rail trips; approximately 85% of the rail trips would be base rail travellers or result from diversion from other modes, principally the automobile; and the rail market share would increase over time (due to energy costs).

2.2 DETROIT-CHICAGO PATRONAGE ESTIMATE: MODEL STRUCTURE AND ASSUMPTIONS; ASSOCIATED PROBLEMS

There are several aspects of the demand estimate and conclusions presented above that need to be reviewed prior to reaching a decision on the feasibility of this system. This is not meant to imply that the estimates are incorrect, but that there are several areas that are unclear and should be subjected to question and clarification prior to acceptance of the patronage estimate.

2.2.1 Model Structure

The "model" that Transmark used is really a chain of individual sub-models roughly organized as follows: trip ends generation is developed through a regression application; trip distribution is based on a "generalized Clawson" approach (apparently a derivation of a standard entropy maximization formulation); modal choice is via a logit model; and assignment is made through a modified all-or-nothing model.

The mode split calculation incorporates trade-off analysis to determine the relative utility of different travel characteristics (i.e., time, cost, frequency); regression to determine the weights of these characteristics in a generalized cost function for each mode; and logit analysis (incorporating the generalized cost function) to determine the potential modal share.

2.2.2 Model Assumptions

Much of the comparison of different options (e.g., 79/3) is to a "do-nothing" estimate which was also presumeably produced using the model package. The do-nothing estimate of 487,000+ trips (see Table 2.1) is 16% higher than the highest demand in the corridor over the last five years for which data were reported (i.e., 1976-1980) in spite of the fact that historic demand was unstable (i.e., down 8.8% for 1976-77, up 1.3% for 77-78, up 18.9% for 78-79, and down 5.3% for 79-80). Another perspective for the 1985 do-nothing estimate is that it represents a 4% increase in patronage for each year (compounded) for five years compared to a total increase of 4%

over the entire prior five year period. While the basis for the 1985 estimate is not completely clear, it appears that it is subject to some question, and, if the model package was employed to obtain it, that methodology also becomes suspect. Furthermore, since other estimates incorporated the do-nothing estimate as a base, they may also be questioned.

The development of the demand estimates for other alternatives, using 79/3 as an example, concluded that there will be an estimated 757,000+ trips in 1985 consisting of 40,000+ new trips, 229,000+ diverted trips, and the do-nothing base of 487,000+ trips. The latter indeed being a constant for all other (higher level-of-service) alternatives. The accuracy of all projections thus depends on the do-nothing estimate. It is also stated that a higher level of service implies a 20% fare increase for rail and that some current rail riders will divert away from rail - an adjustment that, athough stated, does not appear to be explicitly considered in any calculations. Hence, the estimated base train ridership for 1985 (and subsequent years) is based, in contradiction to the report's stated logic, on an assumption that the increased price will not result in losing any ridership and, furthermore, that base ridership would increase (even if no improvements were made) at a consistent rate far higher than has been experienced in the period from 1975 to 1980.

The basic structure of the model may be questioned in two other areas as well. The attitude trade-off component of the model (based on individual responses to a survey) has a basic reliance on the belief that individuals will make decisions consistent with stated (perceived) preferences. That is, the model relies, to at least some degree, on the assumption that when individuals say that they prefer one set of service characteristics to another in the abstract, that they would make a consistent choice when they were actually confronted with such a choice. While an attempt is made to adjust for such a phenomenon not occurring, it is clear even from simple journey-to-work mode split that perceived and actual behavior is not likely to be consistent - for example, travellers do not actually pick the monetarily cheapest mode even though they overwhelmingly indicate that dollar cost is among the most important factors that they consider.

In the basic trip generation model total trips appear to be generated entirely on the basis of per capita income (through use of a regression equation) and exogeneously estimated growth factors for the key cities. While per capita income may be important, the model seems overly simplistic as the basis for predicting intercity travel which would intuitively appear to be driven by significantly more complex mechanisms than this one factor.

Further, the overall model is, as has been described, a series of sub-models chained together to provide a demand estimate. Chained structures, although widely used, have been shown to be subject to considerable error which compounds with each additional "link" as a result of the mathematical manipulations involved. Even if the model is perfectly specified and the only error results from imprecise measurement of the "predictive" variables, it can be shown, for example, that relatively small measurement errors (e.g., 3-5% in measuring per capita income) result, after three or four manipulations involving other variables and predictions, in errors as large as 30% or more in the final quantity to be estimated.

Other assumptions that may effect the estimated magnitude of the potential demand include:

1. The assumption of increasing fuel costs, and a consequently increased patronage of high-speed rail service, may be offset in practice because the fuel economy of automobiles is increasing at a higher rate than stated in the report.

2. The assumption of 55 mph speed limits on freeways, as increases of the speed limits on some highways are being seriously considered.

3. It is not considered likely that airline service would suffer much loss of patronage although business travellers would seem especially likely to divert - the point being that if airlines were fearful of losing their share of the market, they would likely engage in a competitive price/service war with a fledgling rail service. Such a competitive stance could seriously hamper the important short-term profitability outlook for the rail service provider.

2.2.3 Other Problems with the Model

There are several other potential problems with the overall demand model. A sensitivy analysis performed by Transmark to examine the performance of the model under varying assumptions of competition with the automobile seemingly indicated consistent model behavior in predicting changes. For example, if the highway speed limits were changed from a 55 to 70 mph maximum, the outcome of the sensitivity analysis showed that the do-nothing alternative had an 18.2% decrease in demand, with a 13.9% decrease for 79/3, and ranging on downward to only 2% decrease for the 150/12 alternative. These results appear reasonable in that the enhanced service characteristics of the automobile are most competitive with rail when the speeds of each are most nearly comparable. However, further examination of the reported model outputs indicates that the diversions (back to the auto mode) are, in fact, reasonably similar to one another - all service options suffer a 1.7-2.5% decrease in demand. Furthermore, new rail trip generations are predicted to vary by a significant amount when the allowable maximum automobile speed increases from 55 to 70 mph. Specifically, generated (new) rail trips decrease by 31.8% for 79/3, decrease by 23.9% for 110/6, but increase by 24.1% for 150/12 - indicating unstable and unexplainable behavior by the model.

In addition to the above, the model structure is not adequately explained nor are statistics pertinent to model performance provided. For example, the phi-statistic, which is not reported, is normally used to indicate how well the utilities derived from the trade-off analysis perform in terms of "predicting" the rank orderings of alternatives actually indicated by individual respondents.

Mode-specific generalized cost functions are quite similar to one another in terms of the derived coefficients for time, cost, and frequency - e.g., changes in travel times have equal weight in affecting the "cost" of car, rail, and bus modes. It is not clear how the "frequency" component of the generalized cost of automobile travel is, or can be interpreted.

The ultimate modal share was predicted by using logit analysis although the "choices" were apparently examined as a set of binary decisions - i.e., rail vs. automobile, rail vs. bus, rail vs. air. It is not clear why this approach was chosen (or precisely how it was accomplished) over considering the problem as one of simultaneous choice among four modes or as a series of sequential choices - fast modes (high-speed train, plane) vs. slow modes (auto, bus) and then between the two fast modes. Either alternative structure seems more realistic than the one chosen although it is not known how the end result (i.e., modal share) would vary.

2.2.4 Summary of Model Issues

The most serious questions with the estimated demand for high-speed rail passenger service as presented in the Transmark study are as follow:

1. The base prediction for the 1985 do-nothing alternative is quite important as it is the basis for subsequent projections - more detail is required on how the estimate was derived and there needs to be some justification of the significant increase that is projected (4% annual, compounded growth rate) given the modest growth experiences in the 1976-80 time period (4% overall).

2. The linkage between sub-models is unclear - it is not obvious how the outputs from one step are used in the next.

3. Little information is provided in regard to how well the sub-models actually fit the data with which they were calibrated - e.g., the descriptive statistics for the trade-off analysis, the significance of

regression coefficients. Hence, the model performance and outputs are extremely difficult to judge.

4. The sensitivity of the model, as evidenced by the response to an increase of speeds on a mode that competes with rail, is suspect insofar as increased competition apparently results in a large number of (newly) generated trips for the rail alternative already providing the highest level of service.

5. No information is given in regard to the expected accuracy of the demand predictions.

2.3 DETROIT-CHICAGO PATRONAGE ESTIMATE: COMPARISON WITH OTHER EXPERIENCE

The Transmark study indicated that the 1979 modal shares in the Detroit-Chicago corridor were as follow: bus - 2.6%, rail - 4.7%, air - 26.6%, and road - 66.1% of a total of 1,781,000 trips. The study also indicated that approximately 269,800 new trips (over and above the do-nothing base of 487,600 trips) would have been made by rail in 1985 with a 79/3 service, 1,088,300 with 110/6, and 2,135,600 with 150/12. Although the total 1985 corridor trips were never explicitly given in the report it was noted, for example, that in 1985 between 67 and 77% of the total diverted rail trips (for 79/3 and 150/12 respectively) could come from the auto mode or between 153,600 and 1,392,700 trips respectively. That is to say that the amount of travel diverted from the highway system in 1985 could equal from 13 to 118% of the traffic using the road system in 1979. If highway traffic was considered to grow at 5% per year from 1979-1985 (based on Transmark's 1979 estimate of 1,178,000 trips) a total of 1,578,600 trips would be estimated for 1985. This implies that from 10 to 88% of the Detroit-Chicago highway traffic could be diverted to the rail system depending on the service level provided.

The above calculations and estimates can be compared to the experience and estimates for other systems to provide a context for a subjective assessment of the reasonableness of the patronage estimate for Detroit-Chicago.

The Los Angeles-Las Vegas MagLev proposal is for a route 230 miles long which, depending on fare, is projected to capture between 27 and 46% of the estimated 1990 total traffic between the two cities. However, at the lowest fare ($50 round-trip) slightly over 9% of the rail trips would be diversions from the auto with the bulk of the train trips (90%) being new trips.

The most recent estimates in the Los Angeles-San Diego corridor are for 60,000 daily trips (20 million/year) in the corridor by train (using Japanese technology) out of an estimated 360,000 daily trips or a 16% share for high-speed rail with an estimated 43 round-trips/day. The diversion from the automobile apparently accounts for most of the estimated patronage.

In Ohio, where a statewide system had been proposed, the modal shares projected for different city-pairs varied - for example, for the Cleveland-Columbus corridor (142 miles) the rail share goes from 0 (in 1979) to 54.5% in 2000 with all modes decreasing but the auto share dropping dramatically from 87.6 to 36.4%; for Cleveland-Cincinnati (249 miles) the auto share decreases from 74.3 to 26.7% with rail capturing 58.1%;

and for Dayton-Cincinnati (54 miles) the auto share drops only from 97.1 to 81.5% with rail capturing 13.5%. For the Pittsburgh-Cleveland (129 miles) and Cleveland-Detroit (170 miles) corridors, rail shares of 29.5 and 34.1% are projected with 282,600 and 341,400 trips, respectively, being carried.

The successful experience with high-speed rail elsewhere in the world is often cited as a rationale for success of similar technology in the US. In France, for example, the TGV line between Paris and Lyon has been advanced as a key example of successful operation. However, in France rail service already enjoyed an approximate market share of 28% (overall), normal maximum rail speeds of 100 mph, and a passenger-mile growth rate of 3% per year. In addition, the TGV high-speed service was introduced in a corridor where rail service was popular to the point of virtually operating at capacity. Further, the service was offered at no increase in fare but with decreased travel time. The TGV service is expected to divert about 3 million auto trips and 1.5 million from the air as part of a total of an estimated 20 million trips in 1985. The base frequency is hourly service, but during rush periods service with headways of four minutes are offered.

In Japan, another often-cited foreign success, there is a similar successful rail history. For example, in 1975 the Japanese National Railway had a nationwide modal share of 30% with another 15% to private railroads or a 45% total rail share (although down from 76% in 1960) with an increasing number of passenger-miles every year. Thus, even in Japan which is enjoying incredible (by US standards) rail patronage, the modal share is still shifting to the automobile (6% in 1960 to 35% in 1975).

In summary, there appears to be a significant variation in the modal shares (and their components) projected for various US corridors. The US predictions intuitively seem high, and they also appear high when compared to operating experience abroad. In Japan and France, two often-cited "successes" with high-speed rail passenger service, rail service historically accounted for a high modal share and high-speed services were introduced in corridors where rail demand was virtually exceeding supply. Still the high-speed share has not been as high as typically predicted in the US corridors where the current rail share is insignificant. Furthermore, trends in most other countries show that while rail patronage is increasing in absolute terms, the auto mode is increasing its relative share, contrary to predictions for the US.

In conclusion, the projected demand for high-speed rail passenger service in the US and specifically in the Detroit-Chicago corridor appears to have been overstated. This assertion is the result of both an examination of the model that was used for the Detroit-Chicago projection as well as a more subjective comparison with results elsewhere.

3.0 GRADE CROSSING PROTECTION

3.1 INTRODUCTION AND SCOPE OF PROBLEM

There are several issues associated with the provision of high-speed rail service in regard to railroad grade crossing protection. While the need to protect the crossing motorist and train is obvious, guidelines for determining the extent and cost of this protection are not generally available in the United States. Furthermore, existing guidelines for crossing protection in Michigan (and other states) are probably not applicable to high-speed trains. Through consultation with experts in government and the railroad/equipment manufacturing industries as well as a review of numerous manuals and reports, a number of potential crossing protection guidelines were postulated and used as the basis for estimating protection costs for the high-speed corridors in Michigan (including two spurs connecting Grand Rapids with Kalamazoo and Lansing with Jackson). Both spurs would utilize existing track with operating speeds up to 80 mph vs. 120 mph on the mainline. Cost estimates for crossing and track protection for these spurs and the main line are presented herein.

One of the major concerns in regard to crossing protection is the general public's disdain for railroad grade crossing warning devices coupled with the significantly different operating characteristics of high speed rail operations. For example, under current conditions vehicles and pedestrians can often be observed crossing railroad tracks after the flashing lights and bells have been activated. It is not even particularly uncommon to observe vehicles driving around lowered crossing gates - presumably because people cannot see the train or, if they do, conclude there is still time to cross before the train arrives. On the existing system, speeds of up to 80 mph are attained in rural areas (considerably less in urban areas) and the existing crossing protection devices may be adequate. High-speed trains, however, operate at speeds up to 120 mph and will be a new experience to residents in the corridor. Hence, motorist and pedestrian perceptions of an acceptable gap to cross railroad tracks will no longer have the same margin of safety.

For example, if a train approaches a crossing at 50 mph and the flashing lights, bells, and gates are activated 30 seconds prior to the train arrival, the distance between the train and the crossing is 2200 feet or about 0.4 miles. Even at this speed the train may not be in sight for a number of seconds after the protection devices have been activated. However, if the train is travelling at 120 mph, its distance from the crossing would be 5280 feet (1.0 mile) when the protection devices are activated. It is unlikely that the motorist would be able to see the train, thus leading the motorist (or pedestrian) to believe there is sufficient time to cross before the train arrives. Because of the decreased time available to the motorist after the train is visible, more positive protection is necessary at high-speed rail crossings.

3.2 PROCEDURE FOR COST ESTIMATION

The procedure used to estimate the cost of railroad crossing protection was to inventory the existing protection devices at each crossing, apply different postulated guidelines for determining the required protection, and estimate the improvements based on unit costs.

Existing crossing protection was determined by reviewing the existing warrants which consider variables such as track and road alignment, driver sight distance, and vehicle characteristics.

Data were collected from:

1. county maps showing crossing location and road names;
2. railroad stick diagrams showing crossing mileposts and number of tracks;
3. computerized crossing inventories from the Michigan and Indiana transportation departments showing roadway width, average daily traffic (ADT), number of trains and tracks, and any existing protection devices; and
4. computer printouts from the Michigan Department of Transportation (MDOT) Highway Needs Section showing previous crossing data and improvement costs to identify the crossings, their locations (mileposts), number of tracks, number of trains per day, roadway characteristics, and vehicle traffic.

For the spurs, each crossing was field-checked to verify the computer data and provide more precise knowledge of site conditions such as grades, alignments, sight distances, obstructions, and availability of room to make necessary improvements.

Existing grade separations were not considered to require any additional work or other cost expenditure to accomodate high-speed service - the assumption being that the state DOTs would undertake any maintenance work as a part of their normal, ongoing maintenance programs.

3.3 CURRENT AND PROPOSED CROSSING PROTECTION WARRANTS

The MDOT Highway Needs Study used the following warrants for determining costs of protection for a conventional (low-speed) rail system;

1. Grade separation - where ADT x number of trains per day (minimum 6) equals 200,000 or more on any class of roadway.

2. Flashing light signal and gate - where there are two or more tracks, thereby permitting simultaneous movement of trains and where ADT x number of trains per day equals 3,000 or more.

3. Cantilever arm with flashing light signal - where the roadway is more than two lanes wide (one direction) and where ADT x number of trains per day equals 3,000 or more.

4. Flashing light signal - where ADT x number of trains per days equals 3,000 or more.

5. Cross buck - at all active railway crossings with or without additional protection devices.

For high-speed, high frequency rail service, it was assumed that the minimum protection at each crossing would be flashing lights and gates. Lesser protection devices used alone (i.e., 3, 4, and 5 above) were considered inadequate because they did not provide a physical barrier across the roadway, thus allowing vehicles and pedestrians free access to the tracks.

Three alternative warrants for construction of a grade separation were evaluated:

> Alternate 1 - A liberal approach which allows at-grade crossings for all roads with less than 10,000 ADT (and grade separation with ADTs > 10,000).
>
> Alternate 2 - A more stringent approach which only allows at-grade crossings for roads of less than 5,000 ADT in rural areas and less than 6,000 ADT in urban areas.
>
> Alternate 3 - A conservative approach which provides grade separation structures at all crossing locations.

For the purpose of this study, it was assumed that no roads would be abandoned in lieu of grade separations. Hence, the analysis considered a "worst-case" scenario, but did provide a common base for the three alternatives considered.

The grade separation criterion is partially based on the MDOT Highway Needs Study formula specified above - assuming thirty trains per day (fifteen in each direction) on the Detroit-Chicago route, the ADT necessary to justify a grade separation is 6,666. Hence, Alternate 1 uses a more liberal ADT of 10,000, while Alternate 2 is generally comparable to the study.

The distinction between urban and rural was made because of different traffic situations. The less stringent 6,000 ADT was used in urban areas because although urban crossings generally have less sight distance for motorists to see an upcoming grade crossing, slower vehicle speeds have a compensating effect. In addition, the visual distraction from signs, billboards, buildings, and so forth is somewhat offset by an increased awareness of traffic control devices and, subsequently, a higher compliance rate.

3.4 DEVELOPMENT OF COST ESTIMATES

When grade separation is required, the choice between an overpass and an underpass largely depends on whether the crossing is in an urban or rural area. In urban areas, because of high land costs, asthetic concerns, and many existing businesses adjacent to the right-of-way, the use of an underpass is more likely to be justified. Retaining walls would be required since no expansion of the right-of-way was assumed practical. Rural areas, on the other hand, are better suited for overpass construction - with few surrounding businesses and lower land costs, purchase of additional right-of-way to contain the fill slopes is far less costly than constructing retaining walls as assumed necessary in urban situations.

There are several components of the cost of railroad crossing protection: the protection devices, the over/underpass, the pavement at the crossing, and that associated with "protecting" the railroad between crossing locations. Each of these is discussed below.

Each existing at-grade crossing was analyzed in terms of existing conditions and additional improvements required. The unit cost estimates given below represent a synthesis of several separate estimates by MDOT, Transmark, Union Switch and Signal, Safetran, and SAB Harmon. (See Appendix A for the complete estimates.) These costs were then used, as appropriate, to develop overall estimates for each alternative warrant.

Improvement	Estimated Cost per Crossing
1. Grade separation	
underpass	$2,500,000
overpass	$1,875,000
2. Gates, lights, electronics	$ 85,000
3. Gates, electronics (where lights already exist)	
2-lane road	$ 35,000
4-lane road	$ 40,000
4. Cantilever arms, electronics (need to be added to existing gates and lights on 4-lane roadways)	$ 45,000
5. Electronics only (gates and lights already present)	
2-lane road	$ 20,000
4-lane road	$ 40,000

A poorly maintained grade crossing surface may constitute a hazard by diverting the attention of the driver, or in isolated cases, even damaging the vehicle resulting in it stopping on the tracks. Furthermore, poor surface conditions may cause the motorist to slow down on the crossing, increasing the chance of a stopped vehicle on the tracks and/or reducing the speeds of following vehicles. However, the use of active protection devices (gates and lights) even at low volume crossings was considered to obviate the need for highway crossing surface improvements. Hence, the costs of the surface treatments at crossings are not included in the estimates developed herein.

Although grade crossings constitute the major concern in regard to accident prevention, the right of way between crossings is also important. Many rail-related accidents involve unauthorized access to the track right of way (e.g., pedestrians, animals, off-road vehicles) at locations between designated crossings. Again, given the basic character of high-speed operations, special steps must be taken to ensure that such violations are minimized. Hence, two different fencing options were analyzed:

Option I - the entire length of the rail alignment would be fenced with a new six-foot high chain link fence.

Option II - the existing fencing in rural areas was assumed adequate, and the only new fencing required was in urbanized areas.

A number of fencing companies were contacted to obtain cost estimates and to aid in the determination of the type of fence required.

The rail distance from Detroit to Chicago is approximately 290 miles, and fencing was assumed to be needed on both sides. There are also approximately 290 crossings where fencing would be discontinued for a short distance. Assuming each crossing is approximately fifty feet wide, the total length of required fencing for option I is 3,033,400 feet.

The cost of a chain link fence six-feet high, including removal of old fence, clearing the brush, and installation of the new fence is approximately $10.00/ft., and, hence, the cost of option I = 3,033,400 feet @ $10.00/foot or $30,334,000.

The urban area distance calculated for option II includes the entire Detroit and Chicago metropolitan areas as well as small areas such as Dexter, Albion, and Three Oaks. In each case the fencing was extended to the next rural grade crossing to be assured of adequate coverage.

The total length of fence required for option II is based on 115 miles of "urban" area and 135 crossings for a total distance of 1,200,900 feet (@ 10/ft.), which yielded a cost of $12,009,000.

It was assumed that no additional fencing would be required on the two spur routes. This assumption is reasonable since there would be virtually no change from the current maximum allowable train speed (79 mph) to the proposed (80 mph).

The total cost of protection using alternative crossing protection warrants is summarized in Table 3.1. The supporting cost estimates are provided in Appendices A, B, and C.

TABLE 3.1. CROSSING PROTECTION COST SUMMARY

GRADE CROSSINGS

<u>Alternate I</u> (at-grade crossings for all roads with less than 10,000 ADT)

Detroit to Chicago		$ 58,160,000
Lansing to Jackson		15,560,000
Grand Rapids to Kalamazoo		11,000,000
	TOTAL	$ 84,720,000

<u>Alternate II</u> (at-grade crossings for roads with less than 5,000 ADT in rural areas and 6,000 ADT in urban areas)

Detroit to Chicago		$121,385,000
Lansing to Jackson		24,090,000
Grand Rapids to Kalamazoo		17,150,000
	TOTAL	$162,625,000

<u>Alternate III</u> (grade separation structures at all crossings)

Detroit to Chicago		$596,250,000
Lansing to Jackson		128,750,000
Grand Rapids to Kalamazoo		121,875,000
	TOTAL	$846,875,000

FENCING

Option I (new fence for entire alignment)	$ 30,334,000
Option II (new fence for urban areas only)	$ 11,970,000

4.0 SURVEY OF FREIGHT MOVEMENT AND DEMAND ESTIMATE

In addition to revenue passenger service, the provision of high-speed rail operations also provides an opportunity for an ancillary source of revenue - freight services. It is generally conceded that general freight operation (involving a full range of commodities) is incompatible with high-speed passenger service both from scheduling and roadbed maintenance perspectives. Although there is some argument over this assertion, experience abroad has substantiated the general premise (e.g., JNR abandoned their original plans for such general freight service primarily due to maintenance operations required in support of passenger service). However, there appears to be a potential market for a freight service that specializes in high priority, lightweight parcels/packages - similar to the market that is now served by a number of private providers (e.g., Federal Express) and the U.S. Postal Service (USPS) through their "express mail" service. Such high priority service is currently offered in France and the UK in conjunction with their respective high-speed passenger rail services.

The fundamental problem in assessing the potential net revenue that can be derived from such a freight service lies in estimating the demand for the service and the cost of providing this service. The remainder of this section deals with these two issues. More specifically, the following are presented.

1. A review of past work concerning the characteristics of high priority rail freight service in the Detroit-Chicago corridor;

2. An examination of relevant existing freight movement characteristics including the providers, users, and existing rate structure;

3. An estimate of the demand for freight service and the resultant revenue;

4. An estimate of the costs of supplying the service; and

5. A summary and conclusions.

4.1 CHARACTERISTICS OF HIGH PRIORITY FREIGHT SERVICE

A phone survey of 325 businesses involved in freight movements in the Detroit-Chicago corridor was conducted to identify the parameters of high priority rail freight demand - for example:

- What commodities are shipped?
- Are shipments regular, irregular, or seasonal?
- What volumes are shipped daily, monthly, and yearly?
- What is the acceptable shipment time?
- How are shipments packaged?
- What mode of transport is used - why was it chosen?
- What is the shipping cost?
- What is the average weight of shipments?
- Are customers satisfied with the present service?

The results of this survey supported some general conclusions for the Detroit-Chicago corridor:

1. Small firms with less than 200-500 employees tend to be local in nature and typically do not ship significant volumes over long distances.

2. Trucking is convenient and provides door-to-door service - it will, therefore, be very competitive with any new service.

3. Several large companies provide their own shipping service.

4. Some shipments are seasonal and/or irregular e.g., holidays, seasonal food crops.

5. Previous bad experiences with rail service has created a negative image with customers, which will have to be reversed.

6. Existing services are reasonably good, and a premium charge for overnight or one-day service is not necessary for many commodities (e.g., only 23% of 325 respondents required overnight service); express mail and small parcels are the exception. (This point is discussed in more detail later in terms of shippers who currently use air freight.)

More explicit comments on the viability of a high-speed rail freight service were obtained during an MSU-sponsored workshop on high-speed rail service. A number of conclusions were developed regarding the potential for "high-speed freight" as a supplement to passenger service.

1. The additional cost of adding a car, partially or completely devoted to freight, to a passenger train would be minimal.

2. The growth of parcel service and light weight freight in the past ten years has been phenomenal and is expected to continue in the future. This has been demonstrated by the success of United Parcel Service, the USPS, and especially by Federal Express. The latter has been growing approximately 40-50% yearly despite the economic downturn of the early 1980s and increasing competition. These sucesses are consistent with experience in the UK where high-speed rail service exists - the light-weight freight market has increased by as much as five times, resulting in a highly profitable "extra" at a small additional

cost.

3. The priority parcel market is continually changing and a reliable forecast for new service is difficult to develop.

4. "Reliability" is the single most important factor in providing high priority service (cited as most important by one-third of the respondents).

5. Proper marketing will be essential at the outset to attract customers.

6. Containerization will be necesssary to assure quick loading and unloading at all stops.

7. Competition with existing high priority services (e.g., Federal Express) is not considered a problem - in fact, interlining with other providers (such as the USPS) is a possibility.

8. Door-to-door service is costly and already available in most cities. Therefore station-to-station service is considered a more realistic alternative.

4.2 CURRENT STATUS OF FREIGHT MOVEMENT IN THE CORRIDOR

The Bureau of Census' Commodity Transportation Survey (1972) contains a summary of the annual tons of cargo (by commodity class and transportation mode) moving out of various U.S. production areas during 1972. Of the approximately 37,000 thousand tons of cargo leaving Detroit approximately 3.5% is destined for Chicago. Chicago, as the other major production area in the study corridor, ships 70,519 thousand tons of which 5.3% is destined for Detroit. If the rail system went beyond Chicago, even higher volumes could be captured (e.g., 1% of the Detroit cargo is destined for Minneapolis-St. Paul).

4.2.1 Existing Providers of High Priority Services

There are four principal modes by which cargo moves in the study corridor: rail, common motor carrier, private truck, and air although there is also a small amount of parcel movement by bus. The only existing rail service which competes for high priority service is Amtrak between Chicago and Detroit. Common carrier truck service is available throughout the corridor although many large companies have their own fleets of trucks. Air shipments can be made through several firms. In addition, there are companies that use a combination of modes - usually air and truck - thereby providing door-to-door service for the customer.

Whether there will be any "induced" demand as a result of introducing a new carrier or service remains problematic. For example, the service between Chicago and Detroit may be saturated in which case any new "market" would come only from diversions from existing services. From another perspective, introduction of new modes or expanded capabilities in passenger service in a corridor has typically resulted in both diversions and overall increase - the latter being due to decreased congestion and increased overall frequencies of service. If there is an analogy between freight and passenger services, then some net increase in freight movements could be expected. Although a net increase in the high priority freight market is possible, the remaining discussion is based on the former scenario being most likely - that is, a competitive, more-or-less saturated market.

4.2.2 Users of High Priority Freight

Numerous commodities could be considered high priority - varying from small documents shipped for legal purposes to large machine parts needed to restart a halted assembly line. Phone survey respondents generally considered "high priority" to be one-day-or-less service. Such cargo may be moved by express package service or common carrier, and may have a shipped volume of one package, less than a truck load (LTL), or a full truck load (FTL). A majority of larger firms in the survey area could then be classified as "high priority" users. Smaller firms are more likely to be locally oriented and have a tendency to ship by personal delivery or privately owned trucks. Companies that produce items such as electrical components, printed material, and lightweight parts are likely users of high priority services. For example, "current-carrying wiring device" and "switchgear" have among the highest percentages (8.2% and 6.5% respectively) of shipments by air. On the other hand, bulk commodities such as coal, grain, automobiles, and steel, are shipped via rail and truck modes because of the size and weight of the object and the fact that shipping time is generally not a critical factor.

4.2.3 Current Cost/Charge Structure

There are a number of variables used to determine shipping costs: weight, size, volume, and convenience. Express service with pick-up and delivery adds to shipping costs. The following cost ranges for shipping within the Detroit-Chicago corridor were identified from the telephone survey:

1. Cost per pound is used for relatively light shipments where the total volume per shipment is low. The cost range for trucks is from $0.20 to $0.60 per pound. Amtrak rates are approximately $1.00 per pound.

2. Cost per hundredweight is frequently used for longer shipments with a range in rates of from $0.63 to $13.00. For example, the unit cost for glass and building materials is as low as $0.63 while some paper product unit costs are as high as $13.00. The average from the survey results was $6.50 per hundredweight.

3. Cost per parcel also has a wide range depending on the service provided by the carrier. For example, a small fourteen pound package picked up and delivered by Federal Express might cost as much as $50.99, whereas a fifty pound package by a company with only terminal-to-terminal service (with two-or-more-day service) would cost $7.06. The cost difference may be attributed to the pick-up cost and loss of an extra day for service.

4. Cost per mile applies to larger truck shipments and varies from $1.07 to $1.50. Items such as building materials or parts cost approximately $1.10 per mile in the corridor.

4.3 ESTIMATE OF HIGH PRIORITY FREIGHT DEMAND AND GROSS REVENUE

4.3.1 Diversion Criteria

There are a number of points regarding desireable services which were repeated frequently during the survey:

1. About one-quarter of the shippers felt that there is a definite need for an overnight express system between Detroit and Chicago;

2. About one third indicated that reliability is their principal concern with cost almost as important; and

3. Approximately 40% indicated a willingness to pay a reasonable premium for express service, although others are satisfied with two-or-three-day service for a majority of their shipping needs.

Within this context, estimates of the percentage of freight likely to be diverted to high-speed rail from other modes are based on the differences in service characteristics between the current mode and what high-speed rail could provide. Air service appears to offer a similar service, therefore, the assumptions for diversion are based on that mode. Diversions from motor carriers might include some LTL traffic, but probably not a significant volume. Diversions from corporate trucking would be difficult since most companies have an investment in their own vehicles. Since conventional rail typically carries heavy products and bulk loads, diversion is unlikely.

In addition to the freight diverted from other modes, there may be future growth in light weight or parcel service similar to the growth over the past ten years. However, this "induced" traffic, as noted previously, is not considered in this report.

4.3.2 Diversion Estimates

In the Detroit-Chicago corridor actual percentages of air-freighted commodities were used for each commodity in calculating the total volume of cargo. For estimating purposes, high, medium, and low diversion factors were assumed and applied to those commodities currently being shipped by air (according to census data). The range of diversion factors used for the estimates was:

	Diversion from Air to HS Rail
High	75%
Medium	50%
Low	25%

Given the total commodity volume, percentage by air, and percentage diverted, the estimated volumes shown in Appendix D were calculated.

Tables 1 and 2, Appendix D, show selected commodities which are potentially high priority because they are presently shipped by air in the Detroit-Chicago corridor.

4.3.3 Interlining Possiblities

From tentative discussions with freight industry representatives, there appear to be possibilities for interlining, or cooperating, with existing providers. For example, the USPS at one time had contracts with the railroads, but over the years service deteriorated and such contracts were terminated in favor of air and truck service.

USPS data show that priority, express, and first class mail are currently traveling by air or express truck. Yearly volumes are estimated as 473,000 lbs. from Detroit to Chicago, and 1,885,000 lbs. from Chicago to Detroit. Mail volumes and revenue estimates for Detroit and Chicago are also given in Appendix D (tables 7 and 8 respectively). All volumes are based on 1980-1982 USPS reports. Currently the USPS estimates a rate of approximately $0.21/lb. to move this mail. The estimated high-speed rail cost would be $0.16/lb. (25% below current costs - see discussion in section 4.3.4). If the mail contract could be recaptured, the estimated revenue could be as high as $189,000 per year (see table 8 in the appendix). If high-speed service was extended to Milwaukee and Minneapolis-St. Paul a total of over $860,000 could be realized.

Other possibilities for interlining lie with the trucking industry. Some trucking companies have indicated that they would be willing to examine the potential for rail service. On the other hand, UPS has clearly indicated they would not consider interlining.

4.3.4 Estimated Revenue

Once the volume of high priority freight moving in the corridor has been estimated, there are several bases which could be used to calculate the potential revenues:

1) Diverted freight and assumed cost per pound;
2) Diverted freight and assumed cost per package;
3) Comparison with freight at cost per mile.

Revenues can be examined using three conventional shipping rates: per pound, per hundredweight, and per parcel. In order to establish a market for the service, a competitive price must be assumed - hence, service is assumed to be provided at 25% less than the average existing prices (presented in section 4.3.3), and the following rates are used in a calculation of revenues:

1. Cost per pound average = $0.40, offer at $0.30. (For revenue estimates see table 4 in the appendix.)

2. Cost per hundredweight average = $6.50, offer at $4.90 (see table 5 in the appendix).

3. Cost per parcel (avg. = 11.25 lbs.) = $47.79, offer at $35.85 (see table 6 in the appendix).

Based on the above, revenues can be estimated. For example, the Chicago "high" diversion volume of over ten thousand tons (TT) boxed in 11.25 lb. boxes would cost over $85 million dollars to ship at $47.79 per box (or $4.25 per pound). On the other hand, if the same volume could be sent in FTL equivalents (40,000 lbs.), it could be shipped for as little as $63,000 ($125 per FTL or less than $0.01 per pound). Obviously, these are extremes, as not all of this cargo would ever be shipped in 11.25 lb. boxes or as only FTLs. Therefore, table 4 in the appendix, based on a rate of $0.30/pound, represents the most realistic estimate of revenues.

The freight revenue estimate for the Detroit-Chicago corridor is based on both the revenue from the mail and other commodity components. This is summarized in Table 4-1.

TABLE 4-1. FREIGHT REVENUE

	Other Commodity Revenue	Potential USPS Revenue	Totals
Chicago to Detroit			
High Diversion	$6,052,000*	$302,000	$6,354,000
Low Diversion	2,011,000	106,000	2,117,000
Detroit to Chicago			
High Diversion	412,000	76,000	488,000
Low Diversion	138,000	38,000	176,000

* Based on $0.30/pound

4.4 ESTIMATED COST OF PROVIDING FREIGHT SERVICE

Previous studies indicated that cargo movements are not uniform throughout the year. However, to estimate the number of cars needed, a consistent daily volume was assumed over a year with a potential for 125,000 pounds per car. Table 9 in the appendix shows the calculations which provide a "cars needed" estimate - a range from 0.03 to .48 cars/day - which can be used for cost estimates.

Although the exact type of service has not been determined, there are several extra costs that can be identified based on the addition of a cargo service car. A reasonable estimate of additional costs based on an assumption of no pick-up and delivery costs is shown below:

1. Cost of equipment - one car at $600,000.

2. Annualized cost of $600,000 assuming 12% interest over 20 years - $80,328.

3. Extra train crew not required.

4. Parcel loading and unloading by existing station personnel.

5. Extra operating costs is minimal. Assume 5% of operation costs per year for extra fuel and maintenance - 5% x 6/24 trips x $40,000,000* = $500,000.

6. Total operating and capital costs (total 1-5 above) are approximately $581,000 per year.

* Based on current economic feasibility studies.

4.5 ESTIMATE OF NET REVENUE FROM FREIGHT SERVICE

As noted previously, there are several approaches that can be used to draw a conclusion for estimating the revenue of express freight service. The three common shipping rates considered were per pound, per hundredweight, and per package. The most appropriate is per pound, since per hundredweight is too large for the type of service offered and per package is difficult to estimate given significant price variation.

While there are several issues that are not resolved (e.g., pick-up and delivery of USPS freight from stations), an estimate of the annual net revenue from the freight service can be based on the gross revenues and costs developed above and summarized here:

Range of annual gross revenues for Detroit-Chicago corridor:	$2,293,000 - 6,842,000
Annualized capital and operating costs of providing service:	581,000
Net Operating Revenues (Range)	$1,712,000 - 6,261,000

In summary, the demand for high priority freight and cargo service in the Detroit-Chicago corridor was demonstrated by the phone survey results and existing freight and priority mail movements. It has also been shown that the addition of a high priority freight service to an existing passenger train would be minimal in comparison to the possible revenue that could be generated by providing an extra baggage car approximately six times daily although other considerations must be taken into account (e.g., the absence of pick-up and delivery service, seasonal fluctuations, marketing of the service). The freight volume estimates were based on 1972 census data while the mail volume, revenue, and cost estimates were based on the most recent 1980-1983 figures. The overall revenue estimate in any case, whether based on a conservative diversion estimate of 25% or a high diversion rate of 75%, still shows positive net revenues from the addition of high priority freight service to a high-speed rail passenger system.

5.0 OVERALL COST AND REVENUE ESTIMATES

The costs of building, operating, and maintaining a high-speed rail system are dependent on several factors including: availability of existing right-of-way (R/W), selection of technology for the vehicles, the vertical and horizontal geometry of the alignment (e.g., consideration of grade-crossing protection; whether or not system is elevated or depressed), environmental considerations, urban/rural mileage, and number of trains operating. A comprehensive examination of all of these factors is well beyond the reduced scope of this study. However, a rough estimate, based on existing figures for the Detroit-Chicago corridor (from prior studies) and estimates/experience in other corridors both here and abroad, can be made.

5.1 CAPITAL COSTS OF CONSTRUCTION

While a reasonably detailed estimate was made for Detroit-Chicago service based on using diesel-powered trains by Transmark, the details of that estimate are unavailable. However, table 5.1 provides a summary of estimated capital costs for several existing and proposed systems in the US and abroad. As illustrated, there is a substantial variation in the per mile cost. One of the significant contributing factors to this variation is the percentage of the new system that is at-grade, elevated, and depressed. Table 5.2, for

TABLE 5.1. ESTIMATED CAPITAL COSTS OF SEVERAL HIGH-SPEED SYSTEMS

Corridor Cities	Distance (Mi.)	Total Capital (year $)	Cost/Mile
Los Angeles - San Diego	130	$ 3 billion (1983)*	$23 mil
Los Angeles - Las Vegas	230	1.9 billion (1982)*	$ 8.3 mil
N.E. Corridor	456	2.2 billion (actual budget)*	$ 4.8 mil
Ohio - Statewide	500	8.2 billion (1978 with inflation over cost)*	$16.4 mil
Pittsburgh - Philadelphia	300	1 billion (1967 with inflation)**	$ 3.3 mil
Chicago - Milwaukee	79	1.2 billion*	$15.2 mil
Chicago - Detroit	279	700 million*	$ 2.5 mil
Chicago - Detroit	-	-	$ 3 mil***
British Rail Working figure	-	-	$ 4 mil
French TGV estimate	-	-	$ 4 mil
Shinkansen - varies but most recent extension			$35-40 mil

*From Office of Technology Assessment draft report.
**From WABCO study in 1967.
***From Transmark/MSU.

TABLE 5.2 CONTRIBUTION TO CAPITAL COSTS OF A HIGH-SPEED RAIL SYSTEM

Trackwork	14%	Engineering	7%
Structures	35%	Contingencies	15%
Roadway Prep.	7%	Signals & Comm.	2%
Electrification	9%	Stations	1%
Miscellaneous	3%	Maint. Fac./Yards	1%
Right of Way	2%	Vehicles	4%
			100%

example, illustrates the relative cost that structures can contribute (figures taken from the Ohio proposal). The high cost of the Shinkansen extension (in table 5.1) and some of the others are at least partially explained by the high cost of structures. The cost of structures was also found to be significant in the examination of the crossing protection costs - for the Detroit-Chicago corridor they ranged from $58 million with at-grade crossings allowed for all roads with less than 10,000 ADT to $596 million with all crossings assumed to be grade-separated.

In the Detroit-Chicago corridor, the capital cost estimate was based on the following assumptions:

1. The proposed high-speed system would utilize the existing Amtrak routing with minimal additional R/W required.

2. The service would be a single track system with passing sidings.

3. In general, communities would not be by-passed - there is an implicit trade-off between the increased protection required in urbanized areas and the additional cost of the R/W and completely new construction required for a by-pass.

4. There would be no charge for track and no fee for operating on the track.

A fifth assumption was also made - that grade crossing protection would be provided for roads with greater than 5,000 ADT.

Based on these assumptions, the Transmark estimate of capital costs for the Detroit-Chicago corridor was as follows:

1. Track and structures - $650 million

2. Grade crossing protection - $50 million

3. Signalling and train sets - $200 million

For a total of $900 million utilizing diesel technology. Electrification increased the total to $1200 million.

As indicated in an earlier section, later estimates for the grade crossing protection ranged from a low of $50 million to a high of $596 million. It is arguable which level of grade crossing protection is adequate and/or acceptable - both from technical and political points of view. It should be noted, however, that all systems abroad have very positive R/W control and it would appear most likely that the required protection would be greater than that assumed for the $900 million figure.

Given the above and the foregoing table, it would appear that the initial Transmark estimate of the capital requirements is low - for example, with all grade-separated crossings item 2 above approaches the magnitude of the track and structures and surpasses the cost of signalling and train sets. Based on all considerations, it would seem that a more appropriate per-mile cost would be on the order of $5-6 million (which is also directly comparable to similar costs experienced in the Northeast Corridor which was fundamentally a system upgrading).

5.2 ANNUAL OPERATING COSTS

Annual operating costs were also developed by Transmark for the Detroit-Chicago corridor based on the 150/12 service alternative:

1. Operations cost: a total of $40 million
   A) Labor = $20 million
   B) Non labor = $20 million ($13 million for electrification)

2. Interest cost, at 10% for 20 years on the capital investment, of $105 million (or $130 million for electrification).

The above was based on a renegotiated labor agreement for system operation and fuel cost increases being reasonably similar to inflation.

Based on the higher capital costs that were discussed in the previous section, the annual interest cost must be revised upward. Based on an estimated $5.5 million/mile capital cost, the "interest" (2. above) increases to approximately $181 million/year. Thus, total annual operating costs (including capital recovery) increase from $145 to $221 million/year for the diesel option (from $174 to approximately $249 million/year for electric).

5.3 ANNUAL REVENUES

The estimate for annual revenues considers three sources - passenger fares, high-priority freight, and other benefits. Each is discussed in turn in the following paragraphs.

Passenger revenues (from the "farebox") are based on the demand estimates discussed in a prior section. Based on a 20% increase in fare levels, the following revenues were estimated by Transmark for the Detroit-Chicago corridor:

TABLE 5.3 PASSENGER REVENUE ESTIMATE

Service Alternative	Total Revenues 1979 $ (000,000)
Do-Nothing	9.1
79/3	15.2
110/6	28.7
150/12	43.0

High-priority freight revenues were examined in a previous section. These gross revenues were offset by the cost of operating an additional car on the train. The frequency of service, beyond three round trips/day, would probably have little impact on the volume shipped - hence, the net revenues are given only as one estimate and assumed to be independent of service level. The range is from $1.7 to 6.3 million - the wide range resulting from a significant potential variation in such variables as freight diversion estimates, the differential impact (acceptance) of offering station-station vs. door-door service, and seasonal fluctuations.

Other revenues. There are likely to be other positive economic benefits resulting from the implementation of high-speed rail service. These include a variety of items such as consumer surplus, development benefits in and around station cities and along the corridor in general, fuel savings, positive employment and service sector impacts from both construction and operation of the system, and potentially positive long-term environmental impacts. These benefits, although potentially quantifiable, do not result in revenues that would be accrued by (private) system operators, and hence do not enter into the benefit-cost calculus for the feasibility of privatization. It should be noted, however, that if public involvement (in terms of direct or indirect financial support) is contemplated, then this much broader locus of benefits must be considered.

Other benefits (revenues) to be accrued by the operator might include advertising revenues (on-board advertisements), food service, and extra revenues from cooperative arrangements with other transport providers (e.g., local air, bus, or rental car services). Such revenues are assumed to be small (relative to the principal services already cited) and potentially offset by the financial costs of marketing the system in the first place - hence, they are ignored.

In summation, total revenues are expected to be in the range of $15.2 to 43.0 million from passenger service (depending on service option offered) and from $1.7 to 6.3 million for freight service for an overall range of $16.9 million to $49.3 million.

5.4 ESTIMATE OF NET REVENUES

The estimate of net revenues is based on the following items:

1. Annual gross operating revenues ranging from $16.9 to 49.3 million.

2. Annual operating costs ranging from $221 to $249 million.

It is clear then from a purely private point of view that the estimated revenues do not approach the annual operating costs if capital recovery is included. However, if the capital recovery portion of the operating cost is excluded, the annual costs would drop significantly, to an estimated $40.0 million, that is potentially covered by the revenues.

6.0 SUMMARY AND CONCLUSIONS

This study was directed to examining several issues that arise when high-speed rail service is contemplated for any inter-city transportation corridor, specifically Detroit-Chicago, and how these issues are related to a decision as to whether that service might be provided by a private sector supplier. The issues that were considered herein should not be assumed to be the only ones that are important but they are central to any decision regarding high-speed rail service and especially to the feasibility of private operation.

While the study that was undertaken was limited in its scope and in the detail to which certain subjects could be pursued, the findings are nonetheless illuminating in terms of the central issue of privatization. There were four basic areas of inquiry:

1. Review/assessment of passenger demand,
2. Evaluation of grade crossing protection and associated costs,
3. Estimation of potential high priority freight demand, and
4. Estimation of costs and revenues from the private sector's point of view.

6.1 PASSENGER DEMAND

A passenger demand estimate was not developed as a part of this study. Rather, the inquiry focused on a review of the demand estimate that had been developed by Transmark, a consulting firm associated with British Rail, for the corridor in a study funded by Michigan DOT. While this estimate is one of the few (possibly the only) to describe the methodology used, the estimate may be optimistic in terms of the patronage that could be expected. This concern is based on an analysis of the model structure and methodology, Transmark's description of the results of the estimation procedure (e.g., the final demand estimate, results of a sensitivity analysis), and a brief review of findings and experience elsewhere. It should be noted that there may be explanations for the apparent shortcomings with the model/estimate that would serve to mitigate those problems. However, the limited scope of the project did not allow for further clarification.

6.2 CROSSING PROTECTION

Crossing protection was seen to be a potentially major cost of providing high-speed rail service in the corridor. Other cost estimates for rail service in the corridor were seen to have used virtually the lowest possible estimate - consistent with the assumption that grade-separated crossings would be required only in relatively high volume (highway ADT) situations. More conservative assumptions (e.g., with grade separations required in all situatons) resulted in costs for grade crossing protecton that would substantially increase the overall estimate for the capital cost of the system.

6.3 FREIGHT DEMAND

A freight demand (and revenue) estimate was developed based on a survey of businesses in the corridor, a range of diversions from existing carriers (largely analogous to the air freight percentages) for different commodities, and selected interlining possiblities (e.g., for the USPS). Even with the most conservative freight diversion scenario, it would appear that a high priority freight service "add-on" to passenger service would provide the rail operator with a positive net revenue.

6.4 COST AND REVENUE ESTIMATES

The consideration of costs and revenues was limited to those items that would presumeably account for the bulk of the actual cash flow on an annual basis for a private operator. The passenger revenue is estimated to be in the range of $15.2-43.0 million (based on Transmark's estimates) with additional revenue from the freight service in the range of $1.7 to 6.3 million for a total annual revenue of $16.9-49.3 million. The annual operating costs including capital recovery amount to $221-249 million.

From a private sector (service provider's) point of view, the revenue vs. costs outlook is grim, even with an optimistic view of expected revenues. If capital recovery is not included, the operating costs are more-or-less comparable to the revenues on an annual basis. These conclusions do not consider any "social benefits" that may accrue to others (e.g., the public at large; developers in corridor cities; local jurisdictions).

6.5 COMMENTS

This study was, as executed, designed to provide a brief overview of the potential for a private operator to provide high-speed rail service in the Detroit-Chicago corridor. As indicated above the conclusion is that it is extremely unlikely that any such service could "turn a profit" or even come close to paying for itself if the viewpoint is restricted to that of the operator. If the viewpoint is broadened to include the multitude of social benefits that might realistically be expected (e.g., consumer surplus, increased tax rolls), the picture might be significantly altered.

A broadening of perspective, however, assumes that there will be significantly public involvement in system design and operation. Such involvement could occur in one of several forms from the typical urban mass transit capital and operating subsidies to loan guarantees and financial participation on the part of corridor cities which would accrue development benefits.

If, however, the perspective for examining revenues and costs is not broadened, there appears to be little reason to expect the private sector to respond in a positive way to the potential opportunity to operate high-speed rail service in the Detroit-Chicago corridor.

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APPENDIX A

ESTIMATES OF GRADE-CROSSING DEVICES

Source and Amount of Estimate

Improvement	Transmark	MDOT*	Safetran	Union Switch and Signal	SAB Harmon	Cost estimates used in report
Grade separation						
1. overpass	$0.9-3.0 mil	$420,000	--	--	--	$1,875,000
2. underpass	--	630,000	--	--	--	2,500,000
Gates, lights & electronics						
1. 2-lane	150,000	60,000	$85,000	$15,000	$33,600	85,000
2. 4-lane	150,000	60,000	90,000	15,000	41,600	
Gates, electronics						
1. 2-lane	50,000	25,000	35,000	14,000	41,500	35,000
2. 4-lane	50,000	25,000	40,000	14,000	49,500	40,000
Cantilever arm/ lights						
1. 2-lane	--	20,000	40,000	12,000	41,000	45,000
2. 4-lane	--	20,000	40,000	13,000	49,000	
Electronics only						
1. 2-lane	50,000	--	20,000	7,000	30,000	20,000
2. 4-lane	50,000	--	20,000	7,000	38,000	25,000

* Does not include cost of electronics

APPENDIX B

DETAILED ESTIMATES FOR ALTERNATIVE WARRANTS

Cost and Quantity Summary for Alternate 1. At-grade crossings for all roads with less than 10,000 ADT.

		Quantity of Each Improvement Required						
		Detroit to Chicago				Spur Routes		
Crossing Improvement	Unit Cost	Michigan	Indiana	Illinois	Total Cost Each Improvement	Lansing/ Jackson	Grand Rapids/ Kalamazoo	Total Cost Both Spurs
Grade separations								
1. overpass	$1,875,000*	2	0	0	$ 3,750,000	0	0	--
2. underpass	2,500,000*	18	0	0	45,000,000	5	3	$20,000,000
Gates, lights, & electronics	85,000	44	8	0	4,420,000	26	32	4,930,000
Gates, electronics								
1. 2-lane	35,000	50	6	0	1,960,000	14	18	1,120,000
2. 4-lane	40,000	2	2	0	160,000	5	2	280,000
Cantilever arm lights	45,000	1	1	0	90,000	2	0	90,000
Electronics only								
1. 2-lane	20,000	106	17	1	2,480,000	1	1	40,000
2. 4-lane	25,000	4	8	0	300,000	2	2	100,000

TOTAL CROSSING PROTECTION COST: Detroit/Chicago = $58,160,000 Spur Routes = $26,560,000

* See Appendix C for detailed cost estimate

Cost and Quantity Summary for Alternate 2. At-grade crossings for roads with less than 5,000 ADT in rural areas and 6,000 ADT in urban areas; grade separations at all other locations.

		Quantity of Each Improvement Required						
		Detroit to Chicago				Spur Routes		
Crossing Improvement	Unit Cost	Michigan	Indiana	Illinois	Total Cost Each Improvement	Lansing/ Jackson	Grand Rapids/ Kalamazoo	Total Cost Both Spurs
Grade separations								
1. overpass	$1,875,000*	4	0	0	$ 7,500,000	2	2	$ 7,500,000
2. underpass	2,500,000*	40	2	0	105,000,000	7	4	$27,500,000
Gates, lights, & electronics	85,000	44	8	0	4,420,000	25	32	4,845,000
Gates, electronics								
1. 2-lane	35,000	47	6	0	1,855,000	14	17	1,085,000
2. 4-lane	40,000	2	2	0	160,000	4	1	200,000
Cantilever arm, lights	45,000	1	1	0	90,000	1	0	45,000
Electronics only								
1. 2-lane	20,000	85	17	1	2,060,000	1	1	40,000
2. 4-lane	25,000	4	8	0	300,000	0	1	25,000

TOTAL CROSSING PROTECTION COST: Detroit/Chicago = $121,385,000 Spur Routes = $41,240,000

* See Appendix C for detailed cost estimate

Cost and Quantity Summary for Alternate 3. Grade separations at each crossing.

		Quantity of Each Improvement Required						
		Detroit to Chicago				Spur Routes		
Crossing Improvement	Unit Cost	Michigan	Indiana	Illinois	Total Cost Each Improvement	Lansing/ Jackson	Grand Rapids/ Kalamazoo	Total Cost Both Spurs
Grade separations								
1. overpass	$1,875,000*	111	15	0	$236,250,000	26	37	$118,125,000
2. underpass	2,500,000*	115	28	1	360,000,000	32	21	27,500,000

TOTAL CROSSING PROTECTION COST: Detroit/Chicago = $596,250,000 Spur Routes = $250,625,000

* See Appendix C for detailed cost estimate

APPENDIX C

DETAILED ESTIMATE FOR OVER/UNDERPASS CONSTRUCTION

UNDERPASS CONSTRUCTION

Assumptions:

1. Maximum 3% grades on city street

2. Four lane city street section (64')

3. 14.5' clearance beneath railroad crossing structure

4. Double track (40' wide) structure

5. Retaining walls on both sides of the street for entire length of depressed section (approx. 1600')

Estimate:

Railroad crossing structure 64' x 40' x $200/sf =		$ 512,000
Retaining wall		1,056,000
Roadway excavation		137,000
Roadway items (paving, drainage, etc.)		295,000
	SUBTOTAL	$2,000,000
	Contingencies - 25%	500,000
	TOTAL	$2,500,000

OVERPASS CONSTRUCTION

Assumptions:

1. Maximum 5% approach grades

2. 2:1 fill slopes

3. 22' clearance beneath roadway overpass

4. Additional right-of-way required to contain fill slopes

Estimate:

Roadway overpass structure 150' x 84' x $55/sf =		$ 693,000
Approaches (embankment, paving, etc.)		704,000
Right-of-way		100,000
	SUBTOTAL	$1,497,000
	Contingencies - 25%	378,000
	TOTAL	$1,875,000

APPENDIX D

DEVELOPMENT OF FREIGHT DEMAND ESTIMATE

TABLE 1. ESTIMATED COMMODITY DIVERSIONS TO HIGH SPEED RAIL FOR CHICAGO TO DETROIT

CC	VOL	AIR%	DET.	HIGH (.75)	MED (.5)	LOW (.25)
203	749	.1	2.3	.0129	.0086	.0043
2095	41	.3	19.6	.0180	.0120	.0060
20951	41	.3	19.6	.0180	.0120	.0060
23	104	.9	5.3	.0372	.0248	.0124
25	469	.1	5.7	.0200	.0133	.0067
2542	97	.3	1.5	.0033	.0022	.0011
25421	97	.3	1.5	.0033	.0022	.0011
26	906	.3	4.8	.0856	.0571	.0286
264	200	.4	2.4	.0144	.0096	.0048
265	351	.3	2.3	.0182	.0121	.0061
28	7233	.1	7.0	.3797	.2531	.1266
2815	146	.6	6.4	.0420	.0280	.0140
28151	146	.6	6.4	.0420	.0280	.0140
284	953	.3	3.1	.0665	.0443	.0222
2841	457	.5	4.2	.0720	.0480	.0240
29116	405	.7	.3	.0064	.0043	.0022
29521	165	.5	5.9	.0365	.0024	.0012
30	391	.6	6.7	.1179	.0786	.0393
306	40	1.1	17.2	.0568	.0379	.0190
3061	40	1.1	17.2	.0568	.0379	.0190
30619	40	1.1	17.2	.0568	.0379	.0190
307	343	.5	5.6	.0720	.0480	.0240
3071	343	.5	5.6	.0720	.0480	.0240
30719	128	.8	4.0	.0307	.0205	.0103
335	600	.2	4.0	.0360	.0205	.0103
3356	19	1.8	19.4	.0498	.0332	.0166
336	56	.4	21.6	.0363	.0242	.0121
3399	49	2.4	2.9	.0256	.0171	.0086
34	4036	.2	6.7	.4056	.2704	.1352
342	53	.5	4.3	.0085	.0057	.0029
343	23	.3	10.3	.0053	.0035	.0018
34312	12	.6	5.9	.0032	.0021	.0011
345	189	1.2	20.2	.3436	.2291	.1146
3452	189	1.2	20.2	.3436	.2291	.1146
34521	160	1.4	23.6	.3965	.2643	.1322
35	1700	.6	6.5	.4973	.3315	.1658
352	130	.6	2.4	.0140	.0093	.0047
35222	9	1.9	6.0	.0077	.0051	.0026
353	646	.3	7.9	.1148	.0765	.0383
35313	19	.7	2.7	.0027	.0018	.0009
35318	36	.3	4.2	.0034	.0023	.0012
354	269	.1	10.4	.0210	.0140	.0070
3542	105	.1	19.9	.0157	.0105	.0053
35421	105	.1	19.9	.0157	.0105	.0053
356	175	.8	4.5	.0473	.0315	.0158
3569	3	2.6	.7	.0004	.0003	.0002
35691	3	2.6	.7	.0004	.0003	.0002
357	28	1.0	1.0	.0021	.0014	.0007
3579	23	.5	1.2	.0010	.0007	.0004
359	18	6.0	3.4	.0275	.0183	.0094
36	968	3.1	3.2	.7202	.4801	.2401
361	206	1.6	1.4	.0346	.0231	.0116
36131	5	6.5	19.5	.0475	.0317	.0159
362	23	2.1	8.1	.0293	.0195	.0098
3629	7	4.3	.8	.0018	.0012	.0006
364	102	.6	3.1	.0142	.0095	.0048
3642	44	.2	4.2	.0028	.0019	.0010
3643	9	2.8	5.6	.0106	.0071	.0036
36439	2	8.2	4.6	.0057	.0038	.0019
365	61	4.2	1.9	.0365	.0243	.0122
36512	31	.2	2.2	.0010	.0007	.0004
369	130	.3	5.0	.0146	.0097	.0049
37	1463	.9	11.1	1.0962	.7308	.3654
3714	644	2.6	33.1	4.1567	2.7711	1.3856
38	121	1.5	4.1	.0558	.0372	.0186
386	37	1.6	2.5	.0111	.0074	.0037
3861	37	1.6	2.5	.0111	.0074	.0037
39	171	.5	6.9	.0442	.0295	.0150
393	19	.2	15.6	.0044	.0029	.0015
3931	19	.2	15.6	.0044	.0029	.0015
399	90	.3	9.4	.0190	.0127	.0064
3999	37	.3	.1	.0001	.0001	.0000
		TOTAL VOLUME TT		10.0859	6.745	3.3519

CC = commodity code
203 for example is canned and preserved fruits, vegetables, seafoods - see codes in Table 3.

VOL = volume in thousands of tons

AIR% = percent distribution by air for that particular commodity

DET. = percent distribution of that commodity code going from Chicago to Detroit

HIGH (.75) = example calculation for column entry: 749 (thousand tons) x .1% by air x 2.3% Chicago to Detroit x 75% assumed diverted = .0129 thousand tons

TOTAL

TABLE 2. ESTIMATED COMMODITY DIVERSIONS TO HIGH SPEED RAIL FOR DETROIT TO CHICAGO

CC	VOL	AIR%	CHI	HIGH (.75)	MED (.50)	LOW (.25)
26	983	.2	6.8	.1003	.0669	.0335
282	180	.1	1.3	.0018	.0012	.0006
2821	180	.1	1.3	.0018	.0012	.0006
28211	180	.1	1.3	.0018	.0012	.0006
285	597	.1	4.1	.0184	.0123	.0062
2851	597	.1	4.1	.0184	.0123	.0062
30	704	.2	2.1	.0222	.0148	.0074
335	57	.1	7.5	.0032	.0021	.0011
3351	54	.1	7.9	.0032	.0021	.0011
339	120	.2	4.0	.0072	.0048	.0024
3391	115	.2	4.0	.0069	.0046	.0023
33911	115	.2	4.0	.0069	.0046	.0023
34	2731	.3	1.4	.0860	.0573	.0287
346	2232	.4	1.3	.0870	.0580	.0290
3461	2232	.4	1.3	.0870	.0580	.0290
34613	2071	.4	1.3	.0808	.0539	.0270
349	71	.5	2.9	.0077	.0051	.0026
3499	67	.3	3.0	.0045	.0030	.0015
3714	5624	.2	.7	.0589	.0393	.0197
37148	587	.2	.5	.0044	.0029	.0015
37149	2580	.3	1.3	.0755	.0503	.0254
399	3	9.3	.3	.0006	.0004	.0002
3999	2	14.8	.8	.0018	.0012	.0006
		TOTAL VOLUME TT		.6862	.4575	.2295

CC = commodity code
203 for example is canned and preserved fruits, vegetables, seafoods - see codes in Table 3.

VOL = volume in thousands of tons

AIR% = percent distribution by air for that particular commodity

CHI = percent distribution of that commodity code going from Detroit to Chicago

HIGH (.75) = example calculation for column entry: 983 (thousand tons) x .2% by air x 6.8% Detroit to Chicago x 75% assumed diverted = .1003 thousand tons

TOTAL VOLUME TT = thousand tons

TABLE 3. COMMODITY CODES AND DESCRIPTIONS

TCC code	Commodity
	TOTAL. . . . .
20	FOOD AND KINDRED PRODUCTS. . . . .
201	MEAT; FRESH, CHILLED, FROZEN . . . .
2013	MEAT PRODUCTS. . . . .
203	CANNED AND PRESERVED FRUITS, VEGETABLES, SEAFOODS. . . . . .
2033	CANNED FRUITS, VEGETABLES, JAMS, JELLIES, AND PRESERVES. .
204	GRAIN MILL PRODUCTS. . . . .
20421	PREPARED FEED; ANIMAL, FISH, AND POULTRY . . . .
207	CONFECTIONERY AND RELATED PRODUCTS . . . .
2071	CANDY AND OTHER CONFECTIONERY PRODUCTS . . . .
20711	CANDY AND CANDY BARS . . . .
208	BEVERAGES AND FLAVORING EXTRACTS . . . .
2087	MISCELLANEOUS FLAVORING EXTRACTS AND SIRUPS. . . . .
20871	MISCELLANEOUS FLAVORING EXTRACTS AND SIRUPS. . . . .
209	MISCELLANEOUS FOOD PREPARATIONS. . . . .
2095	ROASTED COFFEE, INCL. INSTANT COFFEE . . . .
20951	ROASTED COFFEE, INCL. INSTANT COFFEE . . . .
2096	MARGARINE, SHORTENING, AND TABLE OILS, EXC. CORN OIL . . .
2099	FOOD PREPARATIONS, NEC . . . .
20999	FOOD PREPARATIONS AND BYPRODUCTS, NEC. . . . .
23	APPAREL AND OTHER FINISHED TEXTILE PRODUCTS, INCL. KNIT. .
25	FURNITURE AND FIXTURES . . . .
251	HOUSEHOLD AND OFFICE FURNITURE . . . .
2542	METAL PARTITIONS AND FIXTURES, OFFICE AND STORE. . . . . .
25421	METAL PARTITIONS AND FIXTURES, OFFICE AND STORE. . . . . .
259	MISCELLANEOUS FURNITURE AND FIXTURES . . . .
26	PULP, PAPER, AND ALLIED PRODUCTS . . . .
26219	PAPER, NEC . . . .
264	CONVERTED PAPER AND PAPERBOARD PRODUCTS, EXC. CONTAINERS .
265	CONTAINERS AND BOXES, PAPERBOARD . . . .
2651	CONTAINERS AND BOXES, PAPERBOARD . . . .
26511	PAPERBOARD BOXES AND CONTAINERS. . . . .
28	CHEMICALS AND ALLIED PRODUCTS. . . . .
281	INDUSTRIAL INORGANIC AND ORGANIC CHEMICALS . . . .
2815	CYCLIC INTERMEDIATES AND DYES. . . . .
28151	CYCLIC INTERMEDIATES FROM BENZENE, ETC.. . . . .
2818	MISCELLANEOUS INDUSTRIAL ORGANIC CHEMICALS . . . .
28199	INDUSTRIAL INORGANIC CHEMICALS, NEC. . . . .
282	PLASTICS MATERIALS . . . .
2821	PLASTICS MATERIALS . . . .
28211	PLASTICS MATERIALS . . . .
284	SOAP AND OTHER DETERGENTS. . . . .
2841	SOAP AND OTHER DETERGENTS. . . . .
2844	COSMETICS AND PERFUMES . . . .
28441	COSMETICS AND PERFUMES . . . .
285	PAINTS, ENAMELS, LACQUERS, SHELLACS, AND ALLIED PRODUCTS .
2851	PAINTS, ENAMELS, LACQUERS, SHELLACS, AND ALLIED PRODUCTS .
28511	PAINTS, ENAMELS, LACQUERS, AND SHELLACS. . . . .
28519	PAINTS AND ALLIED PRODUCTS, NEC. . . . .
287	AGRICULTURAL CHEMICALS . . . .
289	MISCELLANEOUS CHEMICAL PRODUCTS. . . . .
2899	CHEMICALS AND CHEMICAL PREPARATIONS, NEC . . . .
28999	CHEMICAL PRODUCTS, NEC, EXC. SEALANTS. . . . .
29	PETROLEUM AND COAL PRODUCTS. . . . .
291	PRODUCTS OF PETROLEUM REFINING . . . .
2911	PETROLEUM REFINING PRODUCTS. . . . .
29111	GASOLINE AND JET FUELS . . . .
29112	KEROSENE . . . .
29113	DISTILLATE FUEL OIL. . . . .
29116	ASPHALT PITCHES AND TARS FROM PETROLEUM. . . . .
295	ASPHALT PAVING AND ROOFING MATERIALS . . . .
29521	ASPHALT AND TAR SATURATED FELTS. . . . .
29523	ASPHALT SHEATHINGS, SHINGLES, AND SIDINGS. . . . .
299	MISCELLANEOUS PETROLEUM AND COAL PRODUCTS. . . . .
2991	MISCELLANEOUS PETROLEUM AND COAL PRODUCTS. . . . .
30	RUBBER AND MISCELLANEOUS PLASTICS PRODUCTS . . . .
306	MISCELLANEOUS FABRICATED RUBBER PRODUCTS . . . .
3061	MISCELLANEOUS FABRICATED RUBBER PRODUCTS . . . .
30619	FABRICATED RUBBER PRODUCTS, NEC. . . . .
307	MISCELLANEOUS PLASTICS PRODUCTS. . . . .
3071	MISCELLANEOUS PLASTICS PRODUCTS. . . . .
30719	FABRICATED PLASTICS PRODUCTS, NEC. . . . .
31	LEATHER AND LEATHER PRODUCTS . . . .
2	STONE, CLAY, GLASS, AND CONCRETE PRODUCTS. . . . .
29	ABRASIVES AND ASBESTOS PRODUCTS. . . . .
292	ASBESTOS PRODUCTS AND ASPHALT FLOOR TILE . . . .
2923	ASPHALT AND VINYL ASBESTOS FLOOR TILE. . . . .
3	PRIMARY METAL PRODUCTS . . . .
31	STEEL WORKS AND ROLLING MILL PRODUCTS. . . . .
312	PRIMARY IRON AND STEEL PRODUCTS. . . . .
3122	IRON AND STEEL PLATES. . . . .
3123	IRON AND STEEL SHEET AND STRIP . . . .
3124	IRON AND STEEL BARS, BAR SHAPES, RODS. . . . .
3127	TIN MILL PRODUCTS. . . . .
33	NONFERROUS METAL PRIMARY SMELTER PRODUCTS. . . . .
3312	COPPER MATTE AND SPEISS (FLUE DUST, RESIDUES, ETC.). . . .
334	PRIMARY ALUMINUM SMELTER PRODUCTS. . . . .
339	MISCELLANEOUS PRIMARY NONFERROUS METAL PRODUCTS. . . . . . .
3399	TIN PIG, SLAG, INGOTS, ETC.. . . . .
35	NONFERROUS METAL BASIC SHAPES. . . . .

TABLE 4. REVENUE ESTIMATE BASED ON "PER POUND" RATE

	TT*	Pounds	Revenue
Chicago to Detroit			
High	10.09	20,171,800	$6,051,540**
Medium	6.75	13,490,000	4,047,000
Low	3.35	6.703,800	2,011,140
Detroit to Chicago			
High	0.69	1,372,400	411,720
Medium	0.46	915,000	274,500
Low	0.23	459,000	137,700

* TT = 1000s of tons

** Revenue example: 20,171,800 lbs. at $0.30/lb. = $6,051,540

TABLE 5. REVENUE ESTIMATED BASED ON "PER HUNDREDWEIGHT" RATE

	Pounds	Revenue
Chicago to Detroit		
High	20,171,800	$988,418*
Medium	13,490,000	661,010
Low	6,703,800	328,486
Detroit to Chicago		
High	1,372,400	67,248
Medium	915,400	44,835
Low	459,000	22,491

* Revenue example: (20,171,800 lbs. / 100) at 4.90/hundredweight = $988,418

TABLE 6. REVENUE ESTIMATE BASED ON "PER PARCEL" RATE

	Pounds	Revenue
Chicago to Detroit		
High	20,171,800*	$64,262,872*
Medium	13,490,000	42,976,142
Low	6,702,800	21,356,817
Detroit to Chicago		
High	1,372,400	4,372,157
Medium	915,000	2,914,987
Low	459,000	1,462,272

* Revenue example: (20,171,800 lbs. / 11.25 lbs/parcel) at
$35.85/parcel = $64,262,872

TABLE 7. PRIORITY, EXPRESS, AND FIRST CLASS MAIL VOLUME MOVEMENTS

	Diversion Estimate	Det-Chi	Chi-Det
High	100%	473,000*	1,885,000
Med.	75%	354,750	1,413,750
Low	50%	236,500	942,500

* Units are pounds.

TABLE 8. REVENUE ESTIMATES FOR USPS SERVICE

	Diversion Estimate	Det-Chi	Chi-Det
High	100%	$75,680	301,600
Med.	75%	56,760	226,200
Low	50%	37,840*	150,800*

* Detroit-Chicago revenue = 37,840 = 150,800 = $188,640.

TABLE 9. ESTIMATE OF RAIL CARS NEEDED

	Pounds (per year)	Daily lbs.	Daily Mail lbs.	Total lbs.	No. Cars Needed per Day
Chicago to Detroit					
High	20,171,800	55,265	5164	60429	.48
Medium	13,490,000	36,959	3873	40832	.33
Low	6,703,800	18,367	2582	20949	.17
Detroit to Chicago					
High	1,372,400	3,760	1296	5056	.04
Medium	915,000	2,507	972	3479	.03
Low	459,000	1,258	648	1906	.03