Analyzing Effects of Highway Rehabilitation on Businesses

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Urban highway rehabilitation projects create problems not only for state highway agencies and motorists but also for commercial premises. For businesses dependent on highway traffic, these projects can potentially disrupt the flow of customers that provide essential business revenue. Notwithstanding the fact that, following the construction, businesses invariably report improved sales from the increased highway traffic, construction projects can be so disruptive as to cause some companies to fail. To reduce these negative effects, highway planners are increasingly expediting construction projects in a variety of ways. An attempt was made to determine whether expediting—an approach that makes use of a systems analysis—in fact provides benefits to adjoining businesses.

The objectives of this study were to develop, first, a set of fundamental questions relating to the effects of urban construction and then a methodology that could be used to answer them—that is, a methodology that could effectively quantify the economic impact of an expedited highway rehabilitation program on a business. We then applied the methodology to an expedited rehabilitation project currently under way on the Southwest Freeway (US-59) in Houston, Texas.

PROPOSED METHODOLOGY

Using information from a literature review (*1*,*2*) and from the Southwest Freeway case study, we posed and then attempted to answer five basic questions regarding the effect of road construction on business activity. These questions included the following:

1. Do road construction activities significantly affect the sales of the abutting business?
2. Do road construction activities of a major corridor significantly affect the economy of the city in which those activities take place?
3. Do road construction activities affect some businesses more than others?
4. Does the use of a public relations officer fully dedicated to an important construction job reduce user and business effects?
5. Does phased construction minimize negative business effects?

To study the effect of construction activities on the abutting businesses, we used two approaches. The first included analyzing historical sales data of the businesses located in the area of the construction activities. In the second approach, we interviewed the owners of businesses located along the road being rehabilitated.

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PROJECT DESCRIPTION

Transportation improvements in the Southwest Freeway Corridor are an important aspect of the Houston regional mobility plan, which consists of a comprehensive network of freeways, major thoroughfares, and transit improvements for the Houston metropolitan area. To provide better mobility for motorists and transit users in the southwest area, the Texas Department of Transportation (TxDOT) and the Metropolitan Transit Authority of Harris County have joined with FHWA and FTA to complete the Southwest Freeway project.

The construction was begun in August 1989 and was scheduled for completion in December 1992. It involves the reconstruction of 11.6 mi (divided into four segments) of the busiest roadway in Houston (and in Texas), one having an average daily traffic volume exceeding 250,000 vehicles per day on some sections. The $200 million project includes freeway reconstruction and widening, as well as construction of a high-occupancy-vehicle lane with associated park-and-ride lots and transit center.

New frontage roads will add as many as two lanes (four lanes total) in some areas, and three lanes (five lanes total) at the major street intersections. The number of main lanes will basically be doubled, from 6 to 12. The high-occupancy-vehicle lane will be constructed in the center of the freeway.

Once completed, the project will provide added freeway capacity, a transitway, improved frontage roads, better intersections, and improved driveways; in addition, users will benefit from better freeway signing, drainage, and lighting.

This massive project has been designated an "expedited" project, and TxDOT has phased the construction plans accordingly. In keeping with such efforts, a full-time project public relations (PR) officer has been employed. Contacting all affected businesses, this officer has attempted to address specific business problems relating to the construction; in addition, the PR effort has worked to ensure the use of all possible media to inform highway users of the various phases of the project and the various traffic management schemes used.

SALES ANALYSIS

In analyzing the effect of Southwest Freeway construction on business sales in the Houston area, we selected a methodology

that involved collecting sales data from the research division of the comptroller of public accounts of the state of Texas. This information, classified by trade industry and zip code, has been collected by the state since early 1984.

The first step in this methodology was to select the city of Houston, the Southwest Freeway project (US-59), and the IH-10 freeway as a control section. The latter was selected for its proximity and geometrical similarity to US-59. The information requested in these reports included the following retail categories: building materials (BUILD), general merchandise (MERCH), food store (FOOD), automotive (AUTO), clothing (CLOTH), home furnishings (HOME), restaurants (REST), drug stores (DRUG), liquor stores (LIQUOR), miscellaneous retail (MISC), and total retail trade (TOTAL).

The second step categorized the zip code information according to three areas: Houston, IH-10, and US-59. We then developed 11 sales-versus-time plots, including total retail gross sales (Figure 1) and the other 10 categories already mentioned in the methodology (*3*). Each figure had two plots: one for the city of Houston and the other for IH-10 and US-59.

In general, Houston total retail sales exhibit cyclical behavior, with the first three quarters showing low sales and the fourth reporting much higher sales. In addition, the figure shows that the economic activity, after decreasing from 1986 to 1988, starts increasing again during 1988. On the other hand, the US-59 corridor shows a behavior similar to that for the Houston area; but the recession that appears in Houston from 1986 to 1988 is less pronounced in this corridor. Finally, the control section shows behavior similar to that for the

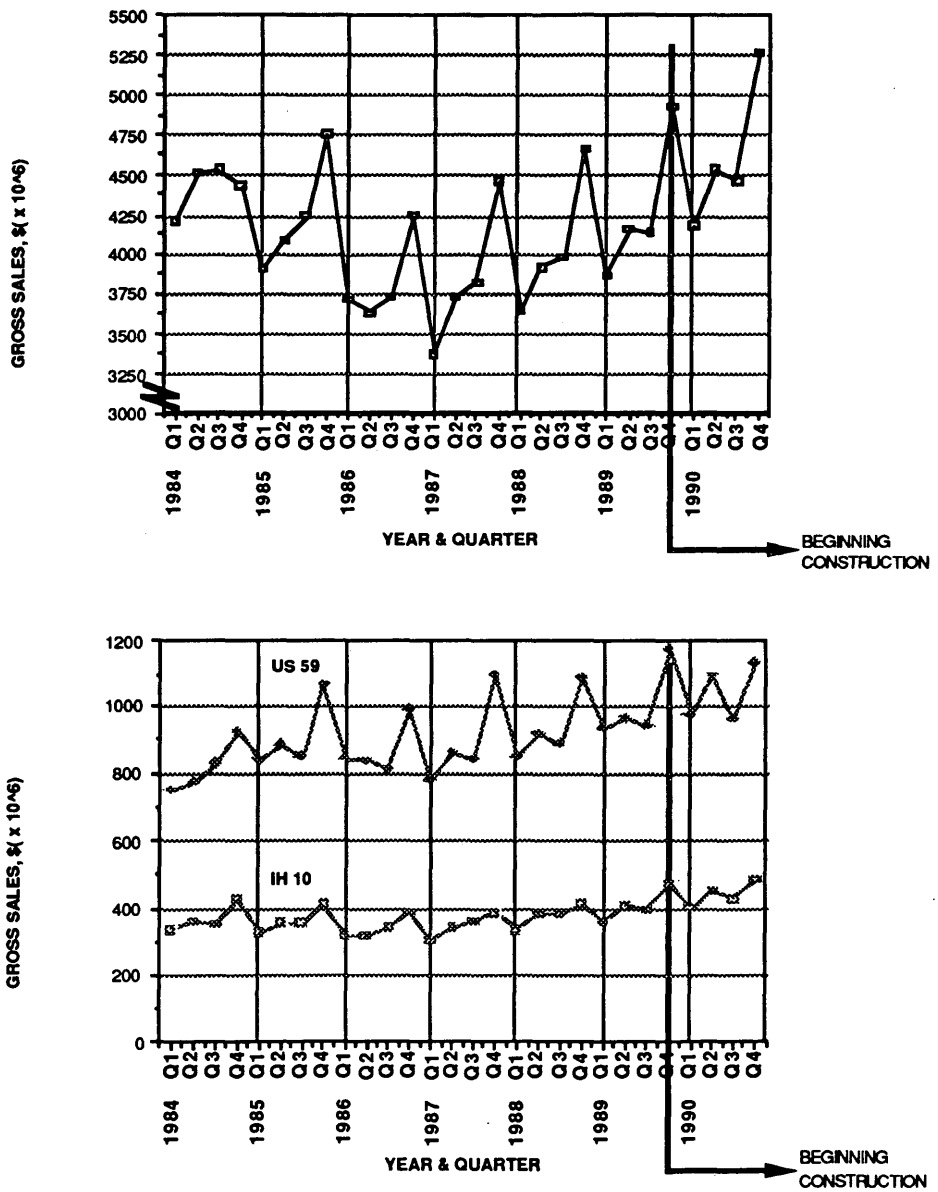

FIGURE 1 Historical sales for total retail: *top*, for Houston; *bottom*, for IH-10 and US-59.

US-59 corridor, but with less pronounced fourth-quarter peaks.

Thus, there is little evidence to suggest that the expedited project on US-59 has had a detrimental total retail sales impact beyond the immediate vicinity of the project.

Methodology

We next looked at an early statistical analysis of the sales data obtained from the comptroller's office to study the impact of the Southwest Freeway project on retail business sales in the project area (*3*). Although this analysis was performed using quarterly information, the results showed that the number of businesses reporting in the fourth quarter was much greater than the number reporting in any one of the other three quarters. The comptroller's office, contacted about this question, explained that some businesses report their sales figures for the year in the last quarter, and these inflate figures in the fourth quarter. Consequently we decided to undertake a new analysis. For this we aggregated the data by year, assuming that all businesses that reported in the first three quarters also reported their sales in the fourth quarter.

The first step was to aggregate the sales data by quarter for each retail category of interest (total of 10 categories) and for each area of interest (total of 3 areas). The next step was to develop a regression equation for each case (total of 33 equations), including the information on the first 5 years (1984 through 1988). The information for 1989 was excluded because the construction started at the end of the third quarter and, hence, included information from both before and after construction began. Next, the sales for 1990 were predicted using the regression equations developed in the previous step; the confidence interval for that prediction, using a confidence level of 90 percent, was also calculated.

We next compared the predicted value with the actual value for that year. For this comparison, we assumed that if the actual value fell between the limits of the confidence interval, the expected value would be statistically similar to the actual value. In addition, if the actual value was greater than the upper limit, the actual value would be statistically greater than the expected value. At the same time, a similar analysis was considered for the lower limits. To include the economic effects in the analysis, IH-10 was introduced as a control section. Thus, to isolate the effects of the construction on US-59, a relative analysis was performed using IH-10 as a base case.

Results

For the city of Houston, 80 percent of the retail categories have actual sales greater than prediced on the basis of historical trends, whereas only 20 percent have no statistical difference between the predicted and actual values. For US-59, 60 percent of the retail categories have actual sales greater than predicted, whereas 30 percent have no statistical difference between the two values, and 10 percent of them have actual sales lower than predicted. Considering the sum of all retail sales, the actual value is statistically greater than the predicted sales for the Southwest Freeway. For IH-10, all retail categories have actual sales greater than predicted. Table 1 gives a summary of these three tables, along with the net effect of the construction on US-59.

As Table 1 indicates, four retail groups—general merchandise, food stores, automotive outlets, and home furnishings—have been adversely affected by the construction on US-59. This is to be expected, given customer mobility, the wide range of consumer choices available, and the difficulty in accessing the businesses on US-59. However, once construction is complete, such businesses generally benefit from the increased traffic passing their business sites. Agencies seeking to minimize these adverse effects should thus work closely with these specific business types, targeting them for special planning considerations.

ANALYSIS OF THE BUSINESS SURVEY

Introduction

Business premises, when adjacent to highway construction work, must weigh the prospect of short-term costs (sometimes claimed to be severe) against possible long-term financial benefits. This trade-off is a critical feature of a mitigation policy and, accordingly, must be evaluated by the planning agency. But there exists in the literature very little information about such effects; moreover, the TxDOT team discovered little about the specific impact of US-59 work on Houston businesses. Despite their considerable effort to inform businesses and to keep them advised of developments, TxDOT did not uncover much hard evidence about economic effects. We therefore decided to conduct a comprehensive business survey that could quantify some of these effects on the Southwest Freeway project; for this, a random sample of the businesses

TABLE 1 Summary of Analysis Results

Retail Trade Categories	Houston	IH-10	US 59	Net Effect using IH-10 as Reference
Building Materials	Similar	Greater	Greater	No effect
General Merchandise	Greater	Greater	Similar	Negative
Food Stores	Greater	Greater	Similar	Negative
Automotive	Greater	Greater	Similar	Negative
Clothing	Greater	Greater	Greater	No effect
Home Furnishings	Similar	Greater	Lower	Negative
Restaurants	Greater	Greater	Greater	No effect
Drug Stores	Greater	Greater	Greater	No effect
Liquor Stores	Greater	Greater	Greater	No effect
Miscellaneous	Greater	Greater	Greater	No effect
TOTAL	Greater	Greater	Similar	Negative

located on the US-59 corridor was selected as a way of representing the views of all businesses adversely affected (*3*).

Business Survey Methodology

There are several ways to obtain the opinions of business managers. One is to mail the survey, requesting that they be completed and returned for analysis. Another way involves direct interview. For this study, we decided to interview business owners directly where possible. When the business owner or manager was unavailable, we left the survey (along with a self-addressed envelope) to be filled out and returned by mail.

The first step was to develop a draft questionnaire. With feedback from two professionals (one a business expert, the other an expert in survey design), the questionnaire was modified and then pilot tested at three different sites in Austin; a modified version of the questionnaire was then prepared and customized to suit the Southwest Freeway project.

At first, a 2-day visit was planned to test the questionnaire on 10 businesses that were contacted and informed in advance of the surveyor's intent. This 2-day visit was organized as follows: for the first day, as many of the businesses as possible were visited up until 4:00 p.m.; after that, the research team went to the base hotel to make phones calls using the users' survey previously discussed; the next day the study team went back to some of the businesses interviewed on the first day to conduct new interviews. At that point, it was clear that some form of sampling was necessary to characterize the large number of businesses located along the 12-mi section. Accordingly, the team estimated the population of active businesses by driving along the frontage road, canvassing and categorizing each business passed.

The next step was to analyze the initial results and modification of the questionnaire. Four additional 2-day visits were made to obtain a sample approximating 20 percent of the total number in the construction area. The last two steps in the methodology included the final analysis of the results and the establishment of the main conclusion of the study.

Identification of the Sample of Businesses Interviewed

Of the 337 businesses counted in the drive-by survey, about 118 were contacted (35 percent). Of all those contacted, 74 (63 percent) responded either by completing the survey immediately or by mailing it to the return address. About half the businesses surveyed filled out the survey immediately.

Table 2 compares the answers received (sample) with the population of the businesses on the Southwest Freeway. Our intent was to survey the 10 different retail categories used for the sales analysis, described in the previous section, and to collect as much data on services as resources would allow. A sample of more than 20 percent was collected for each of the retail categories.

Analysis of the Results

The following analyzes the answers given to the questions asked in the Southwest Freeway survey. The survey form had four parts: (a) general, (b) during construction, (c) after construction, and (d) final comments.

General

About 72 percent said they rented, whereas about 28 percent said they owned their facility. This issue is especially important for those highway projects involving the acquisition of

TABLE 2 Classification of Businesses Existing and Surveyed Along the Southwest Freeway from Shepherd to Beltway 8

Category	Existing	Surveyed	Surv./Exist.
1. Building materials	6	3	50.0 %
2. General merchandise	57	19	33.3 %
3. Food stores	4	2	50.0 %
4. Automotive retails	67	18	26.9 %
5. Clothing stores	20	8	40.0 %
6. Home furnishings	16	7	43.8 %
7. Restaurants	33	8	24.2 %
8. Drug stores	1	1	100.0 %
9. Liquor stores	1	1	100.0 %
10. Miscellaneous stores	30	0	0.0 %
Retail-Subtotal	**235**	**67**	**28.5 %**
1. Travel	3	0	0.0 %
2. Health	36	1	2.8 %
3. Hotel	12	3	25.0 %
4. Insurance	6	0	0.0 %
5. Governmental	2	0	0.0 %
6. Office buildings	29	2	7.0 %
7. Business services	9	0	0.0 %
8. Malls	4	1	25.0 %
9. Churches	1	0	0.0 %
Service-Subtotal	**102**	**7**	**6.9 %**
TOTAL	**337**	**74**	**22.0 %**

right-of-way. About 17 percent of the businesses responded that they had been at that location less than 2 years—that is, they started operating after the beginning of the construction. About 22 percent had been there from 2 to 6 years. About 24 percent had been there from 6 to 10 years, and 37 percent had been there 10 years or more.

Around 23 percent of the individuals were informed by a letter sent to them by TxDOT, whereas 19 percent were notified in person by a TxDOT representative. The media played an important role in the construction coverage: 36 percent of the businesses knew about the construction from the media (24 percent from Houston newspapers, the rest from watching television). These responses answered affirmatively the question related to the importance of a public relations officer. About 76 percent of the businesses were informed about the construction directly or indirectly by TxDOT personnel. About 16 percent considered the communication to be very effective, around 20 percent said it was good, 24 percent said it was normal, and 40 percent said it was poor. Again, these responses tended to confirm the presumed importance of a public relations officer in a mitigation strategy.

During Construction

About 49 percent said that they were affected considerably by the construction. About 32 percent said that they were somewhat affected, about 8 percent said that the effect was minor, and 11 percent said that the construction did not affect them at all. These responses helped to confirm the notion that some businesses are affected more than others. Table 3 summarizes the responses to this question. Almost 47 percent of the respondents considered the economy in Houston a major problem for their business. Some even blamed their poor business performance on the economy and not on the construction. About 34 percent of the respondents thought that the construction imposed the only effect on their business. This question had a wide range of answers. Some respondents said that the construction started 2 years ago, whereas others said that it lasted for 6 months. These discrepancies derive from the fact that construction activity was ongoing on the main lanes even after the frontage road had been completed.

Table 4 shows the responses to how sales were affected during construction. Most of the respondents gave percentages for this answer, like "30 percent down" or "I estimate a 20 percent decrease in sales." Some refused to answer this question because they did not want to reveal their sales records. These responses confirmed that some businesses are affected more than others. Six percent reported improved sales owing to the construction, about 60 percent of the businesses reported that sales were down by less than 20 percent, and only 12 percent reported a sales drop greater than 40 percent.

TABLE 4 Effect on Sales During the Construction Period

Effect	Number	Percentage
Improved	4	6.1 %
No effect	11	16.7 %
Dropped by 10%	8	12.1 %
Dropped by 10% down to 20%	15	22.7 %
Dropped by 20% down to 30%	13	19.7 %
Dropped by 30% down to 40%	7	10.6 %
Greater than 40% drop	8	12.1 %
Total	66	100.0 %

Only 24 percent reported that they reduced the number of employees. Answers to this question included "Did not affect much," "Employees arrive late," and "Laid off two employees." In general, it can be said that the abutting business employee rate did not significantly change as a result of the construction.

The question seeking to identify what TxDOT had done to ease adverse effects evoked a range of answers. These answers were categorized according to the following: communicating, expediting, keeping access open, directing traffic, working at night, putting up signs, making things worse, and nothing (see Table 5).

About 27 percent of the business owners who answered this question said TxDOT communicated with them. (They noted that this communication was appreciated and needed.) Conversely, 55 percent felt that the highway agency did nothing to ease their inconvenience. About 50 percent of the businesses thought that TxDOT was doing something to mitigate the impact on their businesses, whereas the other 50 percent thought that they were doing nothing.

Businesses were then requested to comment on how they mitigated the negative effects of construction. Table 6, which gives answers to this question, indicates that businesses usually advertised, redirected customers, and tried to encourage customer visits with sales and free pickup and delivery; they also requested that TxDOT keep the feeders and business entrances opened.

TABLE 3 Other Internal or External Factors, Besides Construction, That Could Affect Business Activities

Factors	Number	Percentage
Economy	30	46.9 %
Business Strategy	4	6.3 %
Seasonal Variation	4	6.3 %
Competition	2	3.1 %
Media	1	1.6 %
Persian Gulf conflict	1	1.6%
No other Factors	22	34.4 %
Total	64	100.0 %

TABLE 5 Highway Agency Actions To Make Things Easier for Businesses During Construction

Action	Number	Percentage
Communication	17	26.6 %
Expedited	3	4.7 %
Kept access open	2	3.1 %
Directed traffic	2	3.1 %
Worked at night	2	3.1 %
Put up signs	2	3.1 %
Made things worse	1	1.6 %
Did nothing	35	54.7 %
Total	64	100.0 %

TABLE 6 Business Mitigation Strategies

Action	Number	Percentage
Advertise	8	12.5 %
Redirect customers	8	12.5 %
Erect signs for entrances and exits to property	7	10.9 %
Use alternate routes in and out of property	5	7.8 %
Have sales	4	6.2 %
Free pick up & delivery	3	4.7 %
Left home earlier	3	4.7 %
Keep in touch with Highway Department	2	3.1 %
Others	8	12.5 %
Nothing	16	25.0 %
Total	64	100.0%

TABLE 7 Construction Impact on Businesses After Completion of Feeder

Construction Impact	Number	%
No improvement	16	33.3
Business steadily and dramatically picked up	14	29.2
Improved slightly	11	22.9
Construction still going	4	8.3
Helped initially till exits were closed	2	4.2
Business back to normal	1	2.1
Total	48	100.0

After Construction

We next asked what happened after the feeder road construction was completed, and answers are given in Table 7. About one-third of the business owners interviewed noticed no improvement. Others said the construction was still there and the feeder was not yet finished. About 29 percent said that their business improved steadily and dramatically. Only 2 percent characterized their business as being "back to normal." The increase in sales varied from 5 to 30 percent (Table 8). These responses tended to confirm that phased construction reduces business effects. Our survey suggests that the phases undertaken by TxDOT proved to be an effective strategy for mitigating the impact on businesses. By adopting a strategy in which initial operations targeted the lanes directly in front of the businesses, TxDOT allowed these businesses to start receiving the benefits of the rehabilitation before the end of the project.

Final Comments

We asked business owners whether they would consider selling temporary access rights to the contractor and closing during an expedited construction period. Most of the businesses expressed the fear that, if they closed down, customers would seek retail products and services at other locations; thus, about 84 percent said that they would not consider closing down. Only 9 percent said that they would consider closing. The results of the business survey analysis, divided into seven different topics, are summarized in Table 9.

CONCLUSIONS OF THE HOUSTON BUSINESS SURVEY

We now return to the five questions posed earlier in this paper. Road construction can clearly affect sales of abutting businesses; common sense, anecdotal evidence, and the small number of research publications conclusively demonstrate this. This study shows, however, that highway agencies can adopt a range of policies, from construction techniques to closely working with adjoining businesses, to mitigate these effects. In this regard the US-59 project was a great success. Second, construction activities in a major corridor of a large city have a negative effect on a selection of abutting businesses but

TABLE 8 Effect on Sales After Completion of Frontage Road

Effect	Number	Percentage
No positive effect	17	34 %
Sales up 30%	4	8 %
Sales up 25%	3	6 %
Sales up 20%	1	2 %
Sales up 15%	4	8 %
Sales up 10%	5	10 %
Sales up 5%	6	12 %
Back to Normal	2	4 %
Still Dropping	6	12 %
Construction still ongoing	2	4 %
Total	50	100 %

TABLE 9 Summary of Business Survey Results

Topic	Results
Starting of the business	• 17% of the businesses started after the construction began
Information about the construction	• 42% directly from the TxDOT (letters in person) • 36% indirectly from the TxDOT (newspaper and TV) • 10% others • 12% nobody
Effectiveness of the communication	• 60% good- normal • 40% poor
Effect of the construction	• 19% of the businesses said that the construction had little or no effect on their business
Effect on sales during the construction	• 6% improved • 17% no effect • 77% drop
Additional mitigation strategies	• 49% of the businesses said that TxDOT could not do anything differently or do not know
Effect on sales after the feeders were opened	• 34% no effect • 62% positive effect

have no overall regional effects. Construction effects are highly selective, which links to the third basic question posed in the introduction. In particular, general merchandise (−28 percent sales), food stores (−37 percent sales), automotive outlets (−32 percent sales), and home furnishings (−17 percent sales) were found to be particularly vulnerable. Clearly, those projects having a dedicated public relations person should focus attention on these retail categories, which should help reduce adverse business effects. Researchers also believe that the carefully phased construction plans prepared by the agency helped to reduce the negative effects on businesses.

Of course, there is always a problem with drawing general rules from a single (although admittedly large) project. More research needs to be undertaken to develop fully transferable results. However, lessons learned from this study were later applied to a traditional nonexpedited bridge project on I-30 near Dallas, where considerable business complaints had been received. Target businesses were counseled, changes were made to some construction phasing, and traffic management was undertaken. Applying some lessons learned from US-59 led to a more harmonious relationship between the contractor and the abutting business community.

It is likely that an increasing number of urban projects will need to be planned on a systems basis, in which user and business effects are explicitly recognized at every stage in the process. This study of an expedited project shows that this approach can be extremely beneficial to abutting businesses and that many of the inconveniences feared by businesses with respect to urban construction activities can be reduced to tolerable levels.

However, as with any human enterprise, there is a large degree of intrinsic variability that can never be adequately accounted for in a construction project. It is likely, for example, that some businesses will always fail through either mismanagement or insufficient capital, no matter how solicitous the highway department's construction program. Moreover, some highway planners and some public relations officers are more effective than others, although all may adopt an expedited approach. Yet the Southwest Freeway project, undertaken in one of the densest commercial areas in the United States, shows that an expedited approach has the potential to minimize the negative effects that urban highway construction sometimes imposes on adjoining businesses.

REFERENCES

1. J. L. Buffington, W. F. McFarland, J. C. Memmott, and K. N. Womack. *Estimated Impact of Widening U.S. Highway 80 (Marshall Avenue) in Longview, Texas.* Draft Technical Report 1, Research Study 01990. Texas Transportation Institute, Texas A&M University, College Station, Sept. 1987.
2. *Highway Reconstruction and Repair Impact Study.* Legislative Report. Wisconsin Department of Transportation, Nov. 1989.
3. H. de Solminihac. *System Analysis for Expediting Urban Highway Construction.* Ph.D. dissertation. The University of Texas at Austin, May 1992.

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