Louisville-Southern Indiana Ohio River Bridges Project
Indirect and Cumulative Effects Analysis Draft Technical Report
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Authored by Mark Gander.

6.2 Land Use/Community Resources

6.2.1 Introduction. There is an interdependent relationship between land development and the provision of transportation infrastructure. Transportation services must be available to provide access before land can be developed, but the demand for development also creates a demand for access, which in turn increases requests for improvements to the transportation infrastructure. This interdependency complicates efforts to determine the effect of road improvements on land development, because most road modernization improvements are at least partially in response to a growing demand manifested by increases in traffic congestion as population and employment opportunities in an area.

The following is a review of two important sections of the literature. One examines the effect of infrastructure development (highway construction) on overall levels of economic development or growth, while the other looks at the effect of road construction on the allocation of economic development among geographic areas within a region.

6.2.2 National Land Use Trends and Literature Review. A review of pertinent literature was used to set the theoretical context for the ICEA. The following paragraphs summarize the studies reviewed to provide context for the evaluation and research on indirect land use impacts. It was an important part of the Ohio River Bridges Project to evaluate the indirect impacts and cumulative effects of the No-Action and Build Alternatives in addition to other environmental and socio-economic impacts that are an integral part of the EIS.

The literature on the effect of transportation infrastructure on the development of land is large, but reaches few definitive conclusions and provides little empirical guidance. While there is widespread acknowledgment that the provision of major roads and bridges potentially opens land up to development, and that land closer to road and bridge access points is more valuable than land further from access points, there is relatively little analysis of whether this is due to increased levels of development or simply the movement of activity that would have occurred in any case. The academic and other literature has analyzed the effect of road improvements on state and regional economic development, with the results helping to provide context for evaluating the effect of specific road improvements.

Much of the literature on land use impacts from transportation improvements focuses primarily on direct impacts. Direct impacts are the physical, social, and economic effects that can be causally linked to the transportation investment—primarily assumed to be major highway, principal arterial and major highway bridge projects. It is important to understand these direct relationships first in order to understand potential indirect relationships. While direct impacts tend to have immediate spatial and temporal effects, indirect impacts tend to be more widely distributed and long-term in nature. These distinctions between direct and indirect impacts provide clues as to why there is a huge literature on direct impacts and very little devoted to indirect impacts.

The literature on land use impacts from transportation improvements is also very theoretical. Because the dynamics of land use change rely in large part on local and regional economic factors, it is difficult to construct a general framework of analysis that applies to a broad range of circumstances. Discussions of land use and transportation interactions are therefore more abstract and provide little practical advice on how to predict impacts, especially those occurring at a distance from the transportation improvement and perhaps several years into the future. The studies that are most applicable to the current research project are probably the case study style articles in publications such as the *Transportation Research Board (TRB) Record*. These TRB articles generally summarize analyses conducted by researchers, engineering consultants, or transportation agencies and have practical methodological value.

6.2.3 Guidance from Regulatory Agencies. NEPA requires an EIS evaluation to distinguish between direct impacts and indirect impacts. The distinction between direct impacts and indirect impacts is important, because this research was focused on the indirect impacts of transportation on land use.

NEPA, as amended, is the federal statute most relevant to the assessment of indirect impacts. NEPA, however, does not include any specific references to indirect impacts. The CEQ clarified the meaning when it issued its NEPA regulation in 1978. The CEQ says direct effects "...are caused by the action and occur at the same time and place." Indirect effects "...are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable." Moreover, indirect effects "...may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems."

The CEQ differentiates direct and indirect effects from the term cumulative impact. A cumulative impact "...is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions..." (CEQ, 1986). NEPA is based on a concern about "adverse" environmental impacts, but it is clear that impacts can be either positive or negative, and that both are important for decision making. Also, the definition of indirect impacts refers to impacts that are "reasonably foreseeable." This definition is problematic because reasonably foreseeable is not clearly defined.

FHWA also provides guidance on conducting an environmental review of transportation projects (Skaer 2000). That guidance refers to the need to discuss "secondary" impacts, induced development and adverse effects. It does not specifically address indirect impacts, and provides little that goes beyond CEQ definitions regarding the evaluation of indirect land use impacts. (FHWA 2000).

The California Department of Transportation (CalTrans) produced the "Community Impact Assessment: CalTrans Environmental Handbook Volume 4" to provide guidance in meeting environmental regulations and procedures (CalTrans, 1997). This handbook addresses social, economic, and public service impacts as well as land use and growth impacts.

The Wisconsin Department of Transportation published "Indirect and Cumulative Effects Analysis for Project-Induced Land Development" a technical reference guide for evaluating the indirect and cumulative effects of transportation projects (WisDOT, n.d.). This document provides a framework for the analysis, discusses background and reference information, and provides details of analysis techniques. The State of Maryland DOT has also published a reference guide on ICEA.

6.2.4 <u>Other Literature</u>. The literature on the effect of transportation infrastructure on the development of land reaches few definitive conclusions and provides little empirical guidance (Moore, 1994; Hirschman and Henderson, 1990; Giuliano, 1989; Bourne, 1980). Academic literature has analyzed the effect of road improvements on state and regional economic development, with the results helping to provide context for analyzing the effect of specific road improvements (Page and Parkins, 1999; Fisher, 1997; Forkenbrock and Foster, 1990; Rietveld, 1994; Brooks et al., 1993).

This review focuses largely on the urban impacts, although there are substantial possibilities for road improvements to affect rural economic development as well. In particular, the economic literature concentrates either on state level data (e.g., Holtz-Eakin and Schwartz, 1995; Hulten and Schwab, 1991; and Morrison and Schwartz, 1996) or on the effect of urban road investments on the level of economic development (e.g., Deno, 1988 or Duffy-Deno and Eberts, 1991). The key finding of this literature is that total investments in road infrastructure are sufficiently large in most urban areas that marginal investments for road improvements appear to have little impact on the rate of local economic growth. In The Effects of State and Local Public Services on Economic Development, Fisher notes, "Of all the public services examined for an influence on economic development, transportation services, and highway facilities especially, show the most substantial evidence of a relationship. Of the 15 studies reviewed, a positive effect of highway facilities or spending on economic development is reported in 10...[however]...the magnitudes of the estimated effects of highway spending on economic development appear to be quite small." (Fisher, 1997) Hence, the road system is generally acknowledged as being very important in terms of the local economy, but the amount of infrastructure affected over relatively short periods is sufficiently small that it shows little impact on the overall level of growth. These studies are necessarily

rather crude in their attempts to identify the impact of investment, but the results are consistent with expectations.

In 1998, the National Cooperative Highway Research Program (NCHRP) reviewed and summarized the literature on the effect of road development on land use (NCHRP 1998). Three types of induced growth effects are identified with respect to transportation projects: projects planned to serve specific land development, projects that stimulate complementary functions, and projects that influence intra-regional land development location decisions. In the first category, development is planned prior to the road improvement and the improvement is integral to the land use development, e.g., road improvements to provide access to a new regional shopping center. Such improvements allow land development to occur, but the development clearly causes the demand for the road, so the development is not directly induced by the road improvements. In the second case, the development directly serves activity associated with the improvement. The examples presented are "gas stations, rest stops, and motels at highway interchanges" (NCHRP, 1998). These activities are to some extent induced by the existence of the road.

The last category is the one most related to the concerns of the ICEA. This category of induced growth occurs when the transportation facility will likely influence decisions about the location of growth and land development among various locations within a region, a phenomenon commonly referred to as intra-regional development shifts. This category is associated with highway and transit modes. On a regional basis, the impact of highway and transit projects on economic growth appears to be minimal; however, the localized effect of such projects on land use can be substantial. If the conditions for development are generally favorable in a region—i.e., the region is undergoing urbanization—then highway and transit projects can become one of many factors that influence where development will occur.

Extensive research on the topic of the impact of highway on intra-regional locational decisions by others, and a lesser amount of related research on transit impacts, has produced certain generalizations about the circumstances of transportation-induced development shifts. These generalizations relate to the potential nature (type and density) and location of such development shifts; the timing of such shifts is very difficult to forecast as it is highly dependent on the national economy and other factors. Where transportation projects do influence land development, the general tendency is toward relatively high density commercial or multifamily residential development near major roadway nodes: up to 1.6 km (1 mi.) around a freeway interchange; up to 3.2 to 8 km (2 to 5 mi.) along major feeder roadways to the interchange; and up to 0.8 km (0.5 mi.) around a transit station. The exception is the urban fringe where low land prices and high land availability favor single-family residential development (NCHRP, 1998, 79-80). Hence, the effect of road improvements on land development is associated with two important factors: the overall level of growth and related deficiencies in the transportation system. The effect of the road on improving accessibility to specific areas then affects the relative likelihood of development there as opposed to other places.

6.2.5 Land Use Issues. The development of transportation infrastructure can have several types of effects on land development. The provision of transportation services is one of the key inputs into the overall level of development in a region. On the other hand, each individual transportation improvement contributes to the overall level of development but also facilitates development in specific areas. This is particularly evident in suburban areas that have high levels of radial access to central business districts as well as emerging employment concentrations at the urban fringe (Greene, 1980; Erickson and Gentry, 1985). A related concern is whether the infrastructure can influence the type of development that is likely to occur, or more relevantly, the density at which development is likely to occur. To summarize, an issue of the ICEA is the influence of transportation development (roadway and bridges), and with separating the effect of infrastructure on the overall level of development from its effect on the location of development that otherwise would have occurred.

There are several distinctions that should be made in evaluating the impact of road improvements. The first is between urban and rural; the second is between average and marginal impacts; and the third is between different types of highway improvements that provide varying amounts of local access, e.g., the through-route function versus the local access function for roads.

The impact of road improvement on the location of economic activity depends, in part, on the level of economic growth. Where access is limited by low mobility (levels of service) on the road system (i.e., from congestion), road improvements are likely to affect the overall level of economic development. Where access is not severely limited, however, people seem to be able to accommodate new traffic demands by altering behavior, e.g., traveling outside of peak hours. Thus, this analysis tells the reader that he/she needs to know something about the overall level of economic activity before trying to evaluate the land use impact of road improvements on land use. Where growth is slow to moderate, the impact is largely one of moving the location of activities, with little change in the level of activity. However, the impact of road improvements in rapidly growing areas is more likely to be to accommodate a level of development that otherwise would not have been feasible. In these circumstances, the road improvement is likely to affect the overall level of activity as well as the distribution of activity in terms of density and location.

The effect of road improvements on the distribution of land use activity has received much less statistical analysis than the impact on overall levels of economic development. In particular, there is little discussion of the effect that ready availability of accessible land has on the density of development. Anas et al. (1988) summarize the discussion, "Highly accessible land is still underpriced and hence is developed at inefficiently low density. So the resulting land use pattern is likely to be inefficiently dispersed (not clustered enough). It is more difficult to say if the pattern is also inefficiently decentralized (too spread out from the center)..." The literature on this topic relies heavily on the impact of land price on the density of development. Making land available for development is an increase in supply that

reduces the price of such land. The lower price then induces lower density of development (Fare and Yoon, 1981; McDonald, 1981; Jackson et al,. 1984). Metro, the Portland, Oregon metropolitan regional government district, has been analyzing the effect of land price on the substitution of capital for land in the provision of housing and has been working on generating models of this effect for residential construction (Condor and Larson, 1998). However, much less analysis is available on the effect of land price on the density of commercial and industrial development.

From an economic perspective, the ultimate determinant of the effect of road improvements on density of development is the ultimate effect the proposed project has on land prices. For a given land price gradient, differential access is likely to affect the location of activity rather than the level of activity or the density of development. Where large amounts of land with good access are available, the relatively low price of the land should lead to a lower density of development than in situations where limited availability leads to high prices for land. This points out a key issue in analyzing effects of a single improvement on the density of development: in most cases, no single improvement is likely to affect such a large quantity of land such that it will significantly alter the price of land with good access. Hence, it would be difficult to trace the effects of an individual road improvement project on density.

Following Mohring's (1961) early work on highway benefits, a wide range of analyses have been performed that measure the influence of transportation accessibility on land values (De La Barra, 1989; Pendleton, 1963; and Alcaly, 1976). Many of these studies focus on the effect of transportation investments on urban form while others use land value analyses for highway impact assessment purposes (Langley, 1976, 1981; Adkins, 1957). Researchers have also identified land value effects at the urban fringe which typically identify transportation improvements as having a significant relationship with growth pressures (Shonkwiler and Reynolds, 1986; Shi, Phipps, and Golyer, 1997). In these cases, land values are seen as a proxy indicator for potential land use development, where land prices will influence the type and intensity of development.

Previous efforts to quantify the impact of road improvements on land development have been very limited (Deakin, 1989). Some studies have analyzed historical development trends in highway corridors to illustrate the clustering associated with highway improvements (Baerwald, 1982; Hartgen and Li, 1994). However, detecting and quantifying the resulting economies for highway corridor improvements requires detailed historical land use information that typically is not easy to assemble or analyze. In many cases, projections of the impact of road development, as required, for example, in a DEIS, start with an assumption of a fixed amount of activity and travel, then try to determine the effect of the road improvement on mobility (travel times) and other traffic conditions. Often there are statements that deteriorating travel conditions and rising traffic congestion might prevent the expected level of development if road improvements are not made.

More recent studies try to identify likely land use impacts, but there is seldom any quantitative analysis of the effect that the road improvement is likely to have on the future development of land and subsequent demand for use of the road. To conduct such an analysis, it would be necessary to determine both the impact of the road improvement on the total amount of economic activity that would occur in a specific area and the allocation of that activity, both with and without the road improvement. Where the effect is largely a reallocation of activity, some method must be generated to evaluate the impact of the reallocation on the total supply of accessible land, and the effect of this supply change on the price of land and hence on density. Estimating these effects is substantially complicated by the other policy factors that are likely to affect the ability to bring land into development, such as the availability of urban infrastructure, land use regulations, suitability of the land for development, and the other amenity characteristics of the land (such as views or access to recreation). To overcome some of these difficulties, analysts have relied on "expert panels" and other forms of public involvement to incorporate factors that are not easily quantified (CalTrans, 1997; Mulligan and Horowitz, 1988).

The literature is more specific about particular aspects of the transportation and land use relationship. There are empirical analyses on the connection between transportation improvements, land values, and economic development. The results of these analyses, along with supporting economic theory, tend to indirectly account for land use changes. Compared to land value and aggregate economic development analyses, there are few empirical studies of land use impacts resulting from transportation investments. One reason is that information on changes in land use over time is very difficult to obtain while land sales transactions and aggregate economic activity (employment, sales, production, etc.) is much more accessible.

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