Regional Economic Models, Inc.

An Evaluation of Alternative Methods for Reconstructing I-64 in St. Louis

Final Report

Prepared by REMI Consulting, Inc.
for the
Missouri Department of Transportation

November, 2006

Table of Contents

Executive Summary

MoDOT will reconstruct a 12-mile section of Interstate 64 (I-64) between Spoede Road and Sarah Street. This project is scheduled to begin in 2007. To accomplish this, MoDOT plans to use a construction method, known as design-build, to complete this project an estimated four years sooner than the traditional method, known as design-bid-build. The shortened project cycle offers relative economic benefits to the metropolitan area served by a new I-64.

MoDOT traditionally bids construction projects using the design-bid-build method. This method involves several firms; first firms are contracted to design the necessary structures within required specifications and then others are contracted for the actual construction. In contrast, the design-build method uses one firm to both design and construct a project. Design-build allows for greater flexibility in how the project is undertaken and encourages innovative approaches to problem solving. Most importantly for I-64, design-build allows for a project to be completed more quickly than under design-bid-build. The I-64 design-build team will complete major construction by the end of 2009, whereas a traditional approach would take an additional four years, postponing completion until 2013.

MoDOT contracted REMI Consulting, Inc. (REMI) to determine what, if any, economic benefit one construction method has over the other. REMI used an economic and demographic forecasting model designed to evaluate the economic impacts of transportation infrastructure investments.

REMI concluded that the design-build method will produce positive economic benefits over the traditional design-bid-build method due to design-build's shorter construction period, which increases the area's ability to generate economic growth that produces a larger overall economic impact. The broadest measure of regional economic growth, real gross regional product, will increase an estimated $4.173 billion[1] from 2006-2020 under the design-build method versus the traditional method. That is, both methods may grow the economy, but REMI estimates design-build will grow the real gross regional product (final value of goods and services produced in the region) about $4 billion more from 2006-2020, even though design-build has a larger adverse effect on traffic flow and the economy during the construction phase.

Despite the initial relative adverse effects, the design-build method to reconstruct I-64 has greater estimated regional economic impacts from 2006-2020 compared to the traditional design-bid-build for the region—St. Charles and St. Louis Counties, and St. Louis City—as follows:

- Real gross regional product is $4.173 billion greater.
- Total employment—equivalent of number of fully employed people—is, on average, 2,544 greater every year.
- Real disposable personal income is $2.123 billion greater. Real disposable income is personal income minus taxes and social contributions plus dividends, returns from land and capital ownership, and transfer payments.

[1] All real dollar values in this report are in 2000 dollars

- Real total output is $6.779 billion greater. Real total output is real gross regional product plus the value of intermediate production in constant dollars.

Background

The purpose of The New I-64 Project (project) is to reconstruct the section of I-64 mainline from west of Spoede Road in St. Louis County to west of Sarah Street in the City of St. Louis. The project will address several goals: 1) replace the deteriorating facility, including bridges and substandard interchanges; 2) increase roadway capacity between Spoede Road and I-170; 3) improve safety; 4) improve traffic operation and decrease congestion; and 5) promote community redevelopment.

Interstate 64, more commonly known as US40, is an aging highway and is in poor condition. The western section of the project corridor was built in the late 1930s and early 1940s. The eastern section was rebuilt in the late 1950s and early 1960s. The concrete pavement and base are also in very poor condition. When the top surface was removed for resurfacing in 1999, many joint problems were discovered. Most bridges in the corridor are at least 50 years old and none meet today's standards for shoulder widths. All of the bridges have less than 16'-6" clearance with less than 15'-2" (4.6 m) clearance over the majority of local streets. The bridges are deteriorating to the point extensive maintenance is likely to be required in the future to keep a number of them open.

Current roadway design features are based on the prevailing design standards at the time of the original I-64 (US40) construction. The main geometric deficiencies are the existing inside and outside shoulder widths. Insufficient shoulder widths make driving conditions uncomfortable and do not allow for emergency vehicle access following traffic crashes or breakdowns. Also, the existing interchange configurations fail to meet current design standards. The ramp geometrics are too compact, which negatively impacts traffic safety.

The project will reconstruct a 12-mile section of I-64 from west of Spoede Road in St. Louis County to west of Sarah Street in the City of St. Louis. This project also includes I-170 from Clayton Road to Eager Road. The reconstruction includes replacing deteriorated pavement and structurally deficient and functionally obsolete bridges; improving traffic operations, geometrics, and safety; and adding mainline capacity between Spoede Road and I-170. Major improvements will be made to interchanges along I-64 and the Galleria Parkway interchange on I-170.[2]

[2] Financial Plan for The New I-64 Design-Build Project. April, 2006.

The REMI Approach

Methodology

MoDOT traditionally bids construction projects using the design-bid-build method. This method involves several firms; first firms are contracted to design the necessary structures within required specifications and then others are contracted for the actual construction. In contrast, the design-build method uses one firm to both design and construct a project. Design-build allows for greater flexibility in how the project is undertaken and encourages innovative approaches to problem solving. Most importantly for I-64, design-build allows for a project to be completed more quickly than under design-bid-build. The I-64 design-build team will complete major construction by the end of 2009, whereas a traditional approach would take an additional four years, postponing completion until 2013.

MoDOT contracted REMI Consulting, Inc. (REMI) to determine what, if any, economic benefit one construction method has over the other. To answer this question, REMI used TranSight, a multi-year economic impact analysis model we have developed to measure the economic benefits of highway investment. The first component of a TranSight analysis begins with the construction cycle and captures the impact of construction spending as well as delay on the network. The second component is the post construction benefits phase, wherein the network is improved and mobility is enhanced. Details are paid to alterations in access to labor, commodities, and intermediary inputs as a main driver of the increased benefits in the post construction period and reduced benefits during the construction period. Aside from quantifying access change the TranSight model also focuses on changes to safety, emissions, and other regional amenities. For the current study, REMI built a two-region TranSight model. Region 1 is comprised of St. Charles County, St. Louis County, and St. Louis City, and Region 2 is comprised of the rest of Missouri.

To measure the economic impact of a highway investment, TransSight must compare a baseline case where nothing is built to an alternative scenario where the highway investment is made. For this analysis we use the data collected for design-bid-build as the baseline and the design-build data as the alternative forecast. Through this approach we capture the incremental benefits of investing in I-64 using the design-build method versus design-bid-build.

The structure of the TranSight model captures the delta, or difference in, values of travel demand variables such as vehicle miles traveled (VMT), vehicle hours traveled (VHT), and trips made by autos and trucks on the network. These delta values effectively describe the variations of travel distance (captured by VMT) and time per trip (captured by VHT) for auto commuters and for truck drivers on the network given a change from the baseline. For example, when major construction reduces regional traffic operations, usually travel distance and time per trip (VMT and VHT) increase. These travel data delta values between the baseline and alternative are provided by MoDOT from its travel demand model output and are imported into TranSight and characterized as adjustments to the cost of commuting, cost of transporting goods, and the cost of accessing goods. After construction is complete and the regional network is improved, travel time per trip decreases.

As a result, the TranSight inputs this relative change, and the model forecasts the economic benefits of the highway investment.

One of the most interesting facets of this analysis is the way in which the model is applied. The typical REMI TranSight analysis begins with a "no-build" baseline and an alternative "build" scenario. For this I-64 analysis we start with one "build" scenario (design-bid-build) and compare against a second (design-build). Ultimately the purpose of the analysis is to quantify the relative difference of benefits that will accrue if I-64 construction is complete and the roadway is fully open in 2010 as opposed to 2014. This study captures only the relative difference between the two alternative approaches and does not capture the absolute difference from a baseline scenario of not investing in I-64 versus an alternative forecast of either of the alternative approaches. Indeed, it would be impossible to define a no-build or do-nothing baseline, as many stopgap improvements would still need to be made until 2020 simply to maintain the relevant section of I-64. Effectively, the no-build baseline is the design-bid-build alternative. Because of this unique situation, all the analysis in this report only quantifies the relative difference of design-build versus design-bid-build. In this case, TranSight cannot provide stand-alone output data for design-build and design-bid-build independently.

In design-build, the construction cycle is planned to be contained in 2008-2009 with a fully functional and expanded I-64 open to the public by 2010. To accomplish this feat, entire segments of I-64 will be closed and traffic will be rerouted. Travel time will be impacted during this period, meaning VHT will increase. In contrast, the design-bid-build approach plans to keep I-64 partially open and construction will take place from 2008-2013. Lane closures along I-64 during the construction cycle will create some level of rerouting, but not to the same extent as predicted in the design-build approach. Travel time will also be impacted, but not to the same level observed in the design-build approach, and will be carried forward for four years longer than in design-build. Both approaches are estimated to cost $410 million in direct construction costs along with an additional $125 million for management of the project, preliminary design, right of way, and utility relocations for a total project cost of $535 million.[3] These construction costs are entered into the model as final demand increases for the corresponding industries. In our modeling efforts right of way is treated as a transfer payment and does not alter final demand.[4] Based on these demand changes, we calculate the indirect effects on other industries and the induced effects of changes in consumption within the area.

Key Assumptions

MoDOT provided all of the travel data used in this analysis and some simplifying assumptions were made in the preparation of this report. Listed below are the key assumptions of the project:

[3] Financial Plan for The New I-64 Design-Build Project. April, 2006.

[4] Advised by MoDOT

- 2007 travel demand baseline – including VMT, VHT and trips – is an observed 2002 baseline for the region including St. Charles County, St Louis County, and St. Louis City. This model was provided to MoDOT for this study by East-West Gateway Council of Governments (EWGCOG), the Metropolitan Planning Organization (MPO) for the St. Louis region. The 2002 baseline was determined by MoDOT to be adequate to use as the 2007 (existing) regional baseline. Travel demand in the rest of Missouri is assumed to be unchanged during and after construction.
- Expenditures for both approaches is constrained at $535 million—allowing for contractors to place competitive bids in line with a set of critical project needs.
- The design-bid-build 2014 network is the same as the 2010 design-build network to account for the difference in final completion dates between alternatives. In design-bid-build, the New I-64 project lasts from 2007 through 2013. Major I-64 construction would occur from 2008-2013, and the I-64 would open in 2014 with increased capacity. In design-build, the project would last from 2007-2010. Major I-64 construction would be limited to 2008-2009, and I-64 would re-open early by 2010 with increased capacity.
- Travel time from 2014 and onward is the same for both approaches. Regardless of design-bid-build or design build, the region travel times are the same from 2014-2020 because I-64 is built and open with increased capacity in either alternative.
- Trips held constant to 2007 values for both approaches. The same regional travel demand base model was used to code each construction year. So by default, the same number of trips occurred in the model before, during, and after construction. Even though trips were constant, the VHT and VMT values changed based on I-64 construction, so these relative differences were used as input in TranSight to yield comparative economic impacts.
- Different construction plans were coded into the regional travel demand model based on the alternative being evaluated. In design-bid-build, no construction would impact I-64 capacity in 2007 during the design phase. Then, I-64 from west of Spoede to east of Kingshighway was coded as one lane closed eastbound and westbound for years 2008-2013. This allows traffic through the I-64 construction area but at a reduced capacity. In design-build, the construction is shorter but more aggressive. No impact to I-64 lanes was coded during 2007. In 2008, I-64 is closed, or coded as zero lanes open eastbound and westbound, from west of Spoede to I-170. However, I-64 remains open east of I-170 at its full capacity. Plus, I-170's connection to I-64 would remain open east of I-170. In 2009, I-64 was coded as closed from I-170 to east of Kingshighway, but I-64 west of I-170 is re-open at its full capacity. Plus, I-170 maintains its connection to the re-opened section of I-64. The demand modeling results are shown in Figures 6 and 7.

Project Expenditures

Project expenditures fall into six categories:

	Activity	Expenditure (Nominal Millions)
•	Administration	$1.3
•	Preliminary Design	$27.697
•	Right of Way	$66.378
•	Utility Relocations	$3.56
•	Construction Management	$26.065
•	Construction Design-build Contractor	$410
	Total	**$535**

Tables 1 and 2 illustrate how spending on design-build and design-bid-build differ. This is important as it leads to different net effects of the construction activity within the study area.

Table 1. Design-Build Expenditure Schedule by Type

Expenditure Type (Nominal Millions)	2005	2006	2007	2008	2009	2010	Total
Administration	--	0.662	0.159	0.148	0.146	0.187	1.3
Preliminary Design	9.293	7.143	4.003	2.903	2.539	1.817	27.697
Right of Way	13.229	42.688	9.299	1.163	--	--	66.378
Utility Relocations	--	1.795	1.177	0.589	--	--	3.56
Construction Management	--	8.918	7.998	3.242	3.021	2.888	26.065
Construction Design-Build Contractor	--	--	25.663	209.767	174.571	--	410
Total	22.522	61.2045	48.297	217.810	180.276	4.891	535

Note: Figures are rounded.

Table 2. Design-Bid-Build Expenditure Schedule by Type

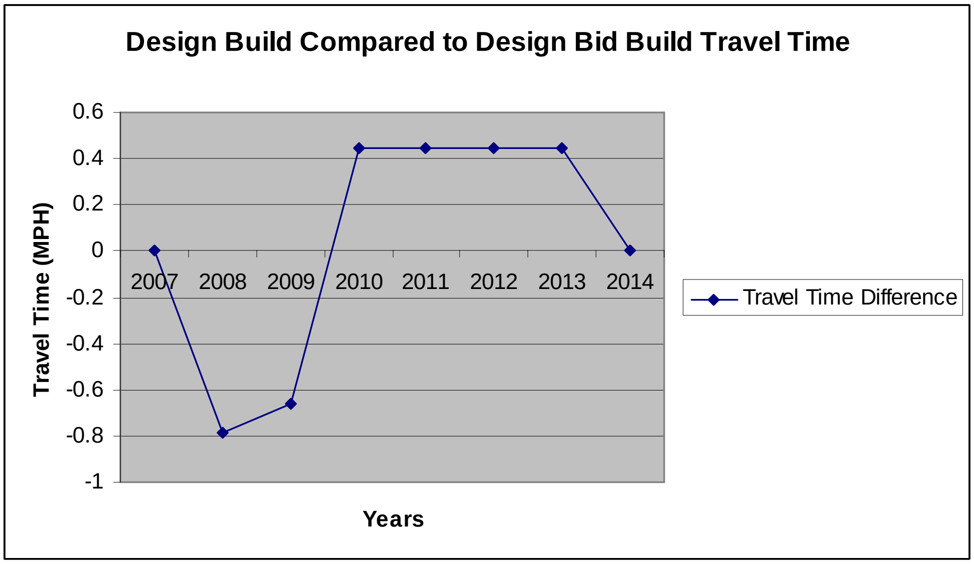
Expenditure Type (Nominal Millions)	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Administration	--	0.631	0.103	0.097	0.093	0.092	0.091	0.085	0.111	1.3
Preliminary Design	9.293	8.044	6.907	3.453	--	--	--	--	--	27.697
Right of Way	13.229	34.552	18.597	--	--	--	--	--	--	66.378
Utility Relocations	--	1.206	2.354	--	--	--	--	--	--	3.56
Construction Management	--	6.511	6.813	3.789	2.016	2.029	1.850	1.476	1.581	26.065
Construction Design-Bid-Build Contractor	--	--	64.156	127.617	85.078	62.204	31.520	20.275	19.149	410
Total	22.522	50.944	98.929	134.956	87.186	64.324	33.461	21.836	20.842	535

Note: Figures are rounded.

Travel Demand Impacts

Travel demand model results were provided for two build out scenarios. Figure 1 (see below) captures the impact on the road network when design-build is selected as the preferred alternative over design-bid-build. As you can see there are certain costs to implementing design-build, most noticeably the sharp inverted spike in travel time during the 2008-09 construction period. Delay on the network caused by traffic being rerouted along parallel routes is the primary reason for the negative impact. 2008 is the most negatively impacted year resulting in a 0.8 reduction of travel time for the network. Of course there are benefits associated with a compressed construction cycle and those benefits are observed from 2010-2013 with travel times improved by around 0.4 for each of the four years. For the years after (2014-2020) we applied the conservative assumption that the network would be operating at a similar travel time.

Figure 1. Travel Time Difference—Design-Build Versus Design-Bid-Build (2007-2014)[5]



Valuation of Ancillary Effects

The REMI TranSight model built for MoDOT enables the analyst to capture the economic effects of changes to safety, emissions, and value of time. These values are derived from the change in VMT and VHT obtained from initial calculations the REMI TranSight model produces for this economic study. Estimates of benefits are treated as regional amenities and are based on research and statistical cohort models produced by the US Environmental Protection Agency (EPA).[6]

[5]Source: MoDOT

[6] Please see Appendix for details.

Analysis Results

Our study focused on capturing the relative economic impact of implementing design-build for I-64 versus design-bid-build. This section contains results on net employment, gross regional/state product, output, and personal income. Our focus is primarily on the economic impact felt within the St. Louis study area. Total state impacts tended to be very similar to the impact on the St. Louis regional run. Tables 3 and 4 summarize the relative economic impacts of design-build relative to design-bid-build. In these tables, the "State of Missouri" values are inclusive of the "St. Louis Area" values.

Table 3. Economic Benefits of Design-Build Relative to Design-Bid-Build for I-64 Investment (2006-2020)

Economic Results	St. Louis Area	State of Missouri
Employment[7] (Average Jobs per Year)	2,544	2,529
Gross Regional/State Product (Cumulative, Fixed 2000 Billion $)	4.173	4.146
Output (Cumulative, Fixed 2000 Billion $)	6.779	6.727
Real Disposable Personal Income (Cumulative, Fixed 2000 Billion $)	2.123	2.295
Average GRP/GSP per capita (Fixed 2000 $)	2,369	649

Table 4. Economic Benefits of Design-Build Relative to Design-Bid-Build for I-64 Investment (2006-2010 and 2006-2014)

	2006-2010		2006-2014	
Economic Results	**St. Louis Area**	**State of Missouri**	**St. Louis Area**	**State of Missouri**
Employment	-3,724	-3,624	2,831	2,706
Gross Regional/State Product (Fixed 2000 Billion $)	-1.59	-1.56	2.68	2.59
Output (Fixed 2000 Billion $)	-2.65	-2.60	4.55	4.41
Real Disposable Personal Income (Fixed 2000 Billion $)	-0.84	-0.91	1.07	1.16

[7] Employment impacts indicate the difference between the levels of jobs projected for each scenario

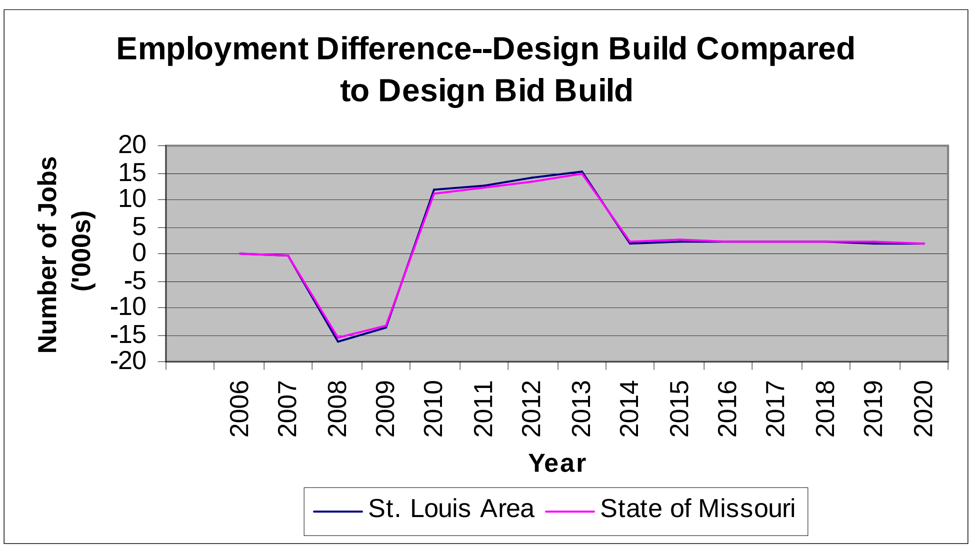
Employment

The employment variable in REMI uses historical data from the Bureau of Economic Analysis (BEA) and is based upon place of work, including part-time and full-time employees. The employment figures projected below are the difference from baseline and should not be cumulated.

Figure 2 illustrates the changes in employment associated with design-build. The impact of design-build as compared to design-bid-build reveals that the operational benefits of the I-64 investment has an initial negative period and then a net increase in terms of employment The relative impact is negative from 2008-2009 largely due to delay caused by the closure of sections along I-64. Large benefits are realized from 2010-2013, peaking in 2013 with 15,350 net new jobs. From 2014 onward the relative impact of design-build is marginalized since we are working under the assumption that the network travel times would be very similar. Economic benefits from 2014 onward are the residual product of the design-build approach realizing a better network four years earlier than design-bid-build.

Essentially, the St. Louis study area receives relatively large gains in labor and commodity access[8] from 2010-2013 and these initial gains effectively increase the base of diversified goods and services that the future St. Louis study area economy can tap into. The economic effects from 2014-2020 capture the relative increases in local production that would not be possible if the advancements in network mobility in 2010-2013 had not occurred.

Figure 2. Design-Build—St. Louis Area and State of Missouri Employment (Annual, 2006-2020)



Gross Regional Product

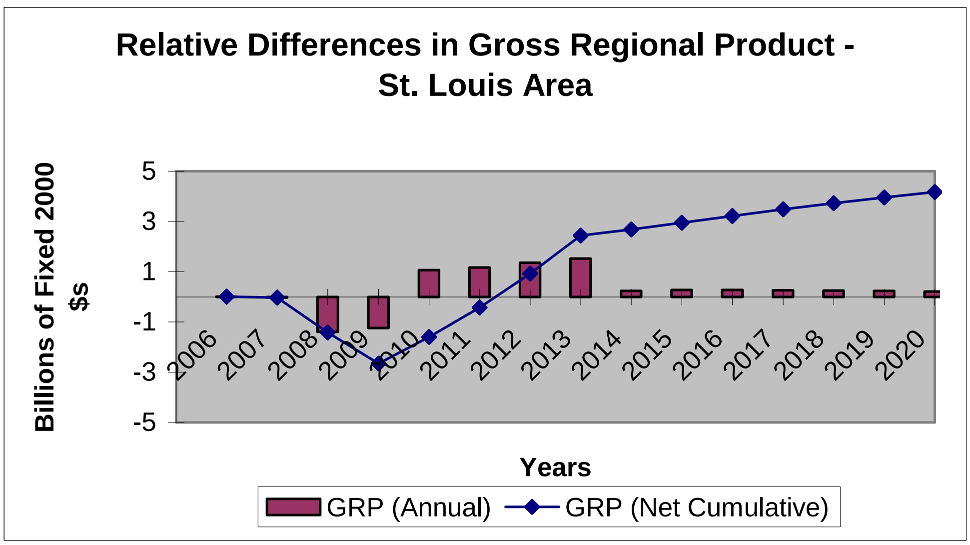
Gross regional product (GRP) and gross state product (GSP) are value-added concepts equal to the value of output, excluding intermediate inputs, produced in the relevant region or state in a year. The

[8] See appendix

value-added concept is equal to compensation and profits. Real GSP and GRP are measures of GSP and GRP after discounting inflation, and are reported in constant-year dollar terms. In this analysis, real values are reported in 2000 dollars.

In our simulation the cumulative change to real gross regional product in the St. Louis study area is $4.173 billion by 2020. The average annual change is roughly $278 million per year. As expected, design-build GRP is lower than design-bid-build GRP in the two major construction years. Sometime between 2011 and 2012, however, design-build recovers that GRP loss as the benefits of the completed I-64 begin to accrue. Due to the earlier realization of mobility on I-64, the design-build approach allows for the St. Louis area economy to grow. The primary driver of this growth is the relative increase in labor and commodity access that occurs from 2010-2013. As the cost of doing business declines due to enhanced access to diversified labor and inputs the level of exports and employment increase. The employment increase leads to higher levels of disposable income and additional consumption.

Figure 3. St. Louis Area Change to Gross Regional Product (2006-2020)

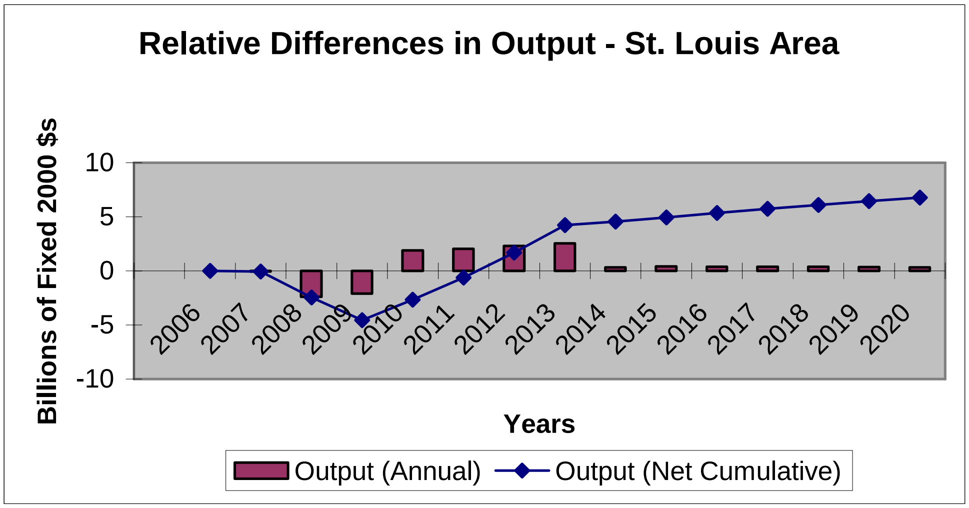


Output

The output of an economy is the value of all intermediate goods purchased in one year as well as GRP (or GSP). We can also think of output as sales for both final goods and intermediate goods. Output is dependent upon consumption in the area, state government spending, investment, and exports of the industries in the region.

For the St. Louis study area the investment in I-64 creates a net increase of $6.779 billion in real output, and an average of $452 million per year. As the relative price of doing business in the St. Louis area drops the total number of new transactions between local businesses and exports to outside the region increase. This growth is primarily due to the added mobility of workers and goods on I-64 realized four years earlier through the design-build approach.

Figure 4. St. Louis Area Change to Output (2006-2020)

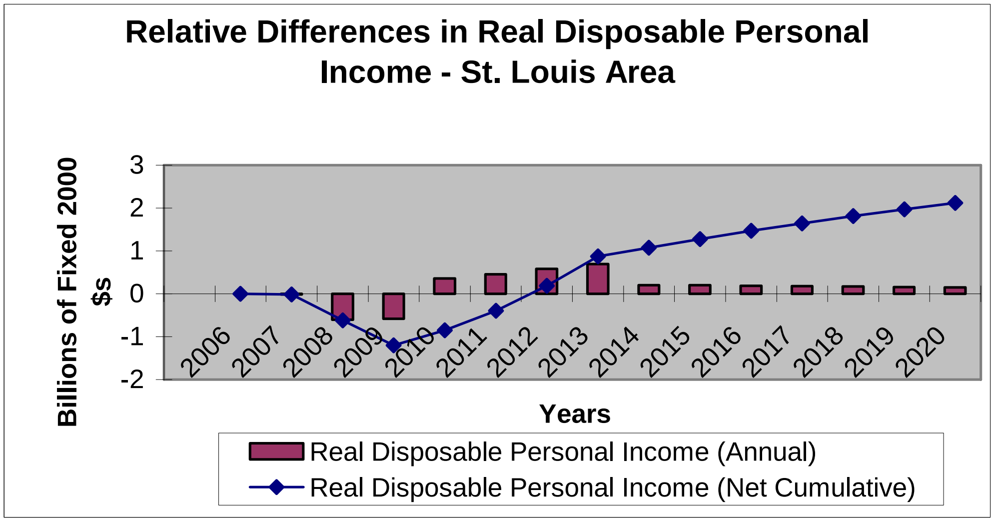


Disposable Income

Real disposable personal income (RDPI) is the inflation-adjusted income that is available for consumers to spend. It is personal income minus taxes and social contributions plus dividends, rents, and transfer payments. The numbers of employees in the area, their wage rate, and the consumer prices all affect RDPI. An increase in employment or wage, or a decrease in consumers' prices increases a region's RDPI. Conversely, the opposite decreases RDPI. The increase in RDPI is an indirect effect of the new jobs in the regions. The summation of new wages, minus taxes, earned by workers equals the increase in RDPI.

Real Disposable income increases in the St. Louis study area by $2.123 billion in 2020 as the reduced cost of doing business in the region enables local firms to sell more goods and services. Given greater demand for products, a need for more employment is met through the local labor pool and job-seeking economic migrants. As employment increases, so does disposable income. On average the region gains $142 million of net new real disposable income a year.

Figure 5. St. Louis Area Change to Real Disposable Personal Income (2006-2020)



Appendix

REMI TranSight

Regional Economic Models, Inc. (REMI) developed a custom TranSight model for MoDOT that describes two regions: 1) The City of St. Louis, St. Louis County and St. Charles County aggregated as one region, 2) The rest of Missouri. This configuration allows REMI Consulting Inc. to estimate the economic impacts for the immediate area as well as for the state as a whole. Once the travel data and project-specific data are entered into TranSight, the model translates the information into REMI Policy Variables, and enters the data into REMI's Economic and Demographic Forecasting and Simulation model for 70 Industrial Sectors (EDFS-70). EDFS-70 includes the REMI economic and demographic baseline forecast, or no-build scenario, and produces multi-year forecasts, comparing them to the baseline forecast.

The travel-model results are interfaced through a custom import in TranSight and impacts are calculated by EDFS-70 through the transportation cost matrix, which includes individual matrices for transportation costs, accessibility costs, and commuter costs. The travel data enter each individual matrix as changes to "effective distance."[9] These changes are then passed onto EDFS-70 as changes to delivered costs, production costs, and commuter costs for the region.

The change in truck movement (VHT, VMT, & Trips) enters the matrix as changes to transportation cost. The cost reduction or increase then enters the delivered-price equation and composite input-costs equation for each industry sector found in the Wage Price and Profit Block. The Accessibility Cost Matrix captures and quantifies the impacts of access to diverse consumer goods and services by households, as well as access to a broader array of intermediate inputs by employers. Inputs to the accessibility cost matrix are calculated from the change in truck-trips per hour. The data from the accessibility cost matrix then enter into the output block as changes to the intermediate-input access index, which represents a price elasticity of demand[10] (price is sensitive to distance) and then feeds into the commodity access index, giving both businesses and consumers more or less access to commodities.

The commuter cost savings over the average workday are entered into the model as savings in respect to movement (VHT, VMT, & Trips). These effective-distance changes enter the occupation labor access productivity equation found in the Labor and Capital Demand block in EDFS-70, which feeds into the industry labor-access productivity. Improvements in transportation would then mean an increase in labor access, which would allow businesses to take advantage of a larger labor pool.

[9] See Appendix: "Effective Distance: The Transportation Cost Matrices"

[10] Measures how the quantity demanded responds to a change in prices

TranSight uses motor-vehicle emissions rates obtained from the PART5 and MOBILE6b models developed by the EPA to specify emissions rates per vehicle-mile for specified pollutants. These pollutants include carbon monoxide, nitrogen oxides, volatile organic compounds, sulfur oxides, and particulate matter. Default emissions costs are based on a study by McCubbin and Delucchi[11], who quantify the health effects of vehicle pollution per VMT in the average urban area and the nation as a whole. TranSight uses these costs per gram for both motor-vehicle and public-transit modes. The change in emissions cost relative to baseline levels enters into the model as a non-pecuniary amenity, found in the Demographic block in EDFS-70, which accrues to workers and their dependents[12].

TranSight includes annual mode-specific rates for three accident-consequence categories: fatalities, injuries, and Property Damage Only (PDO). TranSight also provides default cost-per-accident figures for each transportation mode, broken down by accident-consequence category. REMI bases these values on National Safety Council figures that incorporate wage and productivity losses, medical and administrative expenses, motor-vehicle damage, and a willingness to pay to reduce safety risks[13]. Using national average costs reported by the Federal Highway Administration, TranSight was calibrated to the local area roadway conditions. As with emissions costs, TranSight transfers these changes in safety costs into EDFS-70 as adjustments to the non-pecuniary amenities that affect individual welfare, which will induce a migration response in the demographic block of EDFS-70. Even for people not involved in accidents, the prevailing local accident rate, along with associated insurance and medical costs, can influence the relative attractiveness of living and/or working in a particular region influencing migration.

These costs then proceed to influence private decision-making by households in accordance with the tenets of the new economic geography, as articulated by Fujita et al.[14] and applied to regional macroeconomic modeling by Fan, Treyz, and Treyz[15]. This theory emphasizes the geographic location decisions of firms, demonstrating how improved access to intermediate inputs and a diversely skilled labor force can provide incentives for industries to cluster and agglomerate.

[11] McCubbin, Donald, and Mark Delucchi, "The Social Cost of the Health Effects of Motor Vehicle Air Pollution." Report 11 from The Annualized Social Cost of Motor-Vehicle Use in the United States. Institute of Transportation Studies. University of California-Davis. 1996.

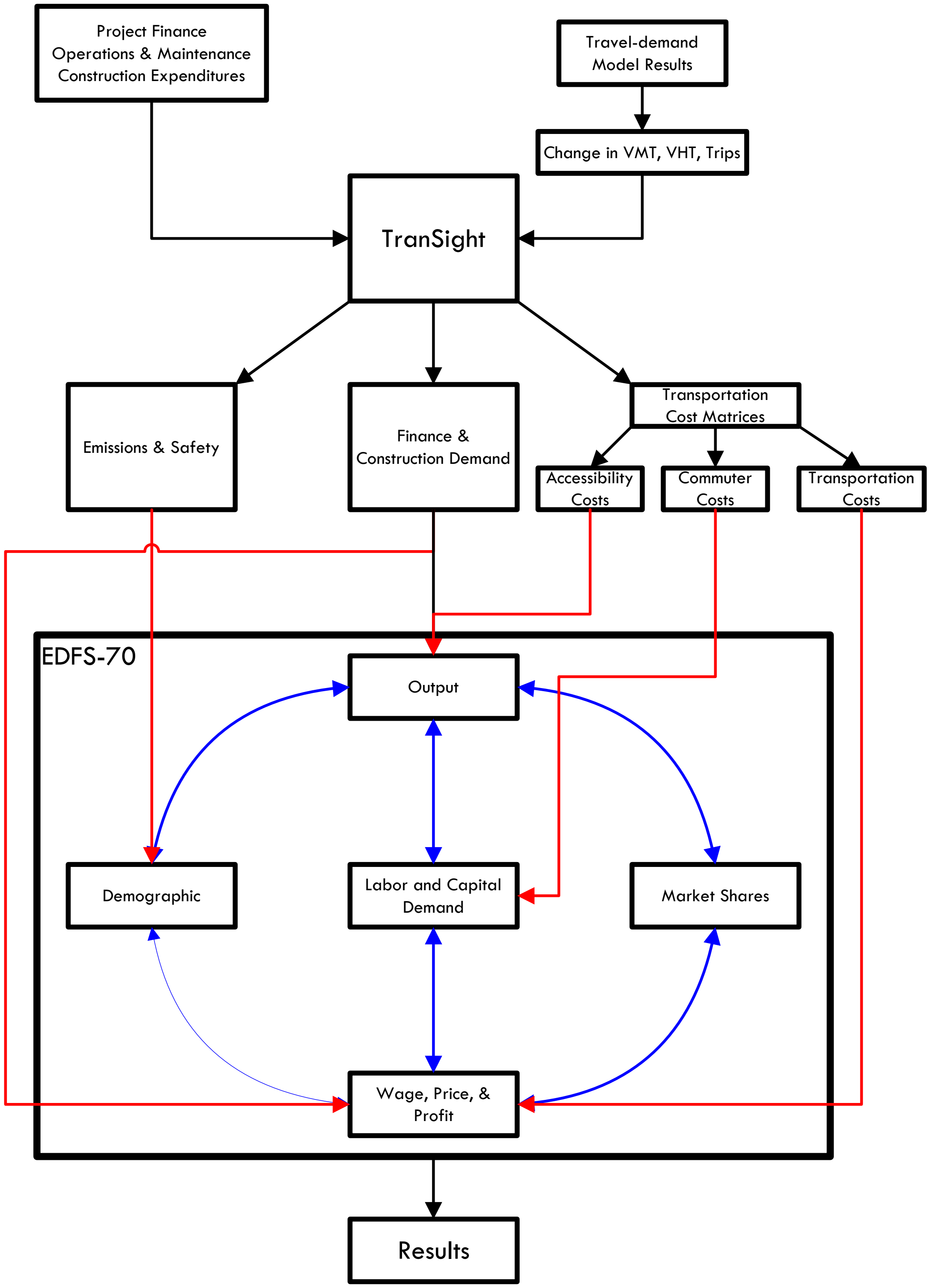
[12] Lieu, Sue and G. I. Treyz, "Estimating the Economic and Demographic Effects of an Air Quality Management Plan: The Case of Southern California." Environment and Planning 24 (1992): 1799-1811

[13] National Safety Council, Estimating the Cost of Unintentional Injuries.

[14] Fujita, Masahisa, Paul Krugman, and Anthony J. Venables, The Spatial Economy: Cities, Regions, and International Trade. Cambridge, MA: MIT Press, 1999.

[15] Fan, Wei, Frederick Treyz, and George Treyz "An Evolutionary New Economic Geography Model." Journal of Regional Science 4 (2000): 671-695.

Model structure of TranSight



Travel Data

Figure 6. Design-Build Travel Data for the St. Louis Study Area, Daily Values (2007-2020)

Design-Build Travel Data

	VMT			VHT			VTT			
Year	AUTO	TRUCK	TOTAL	AUTO	TRUCK	TOTAL	AUTO	TRUCK	TOTAL	VMT/VHT
2007	38900333	4167367	43067700	3537457	387685	3925142	7013584	712118	7725702	10.972
2008	38970551	4173221	43143772	3975671	435510	4411181	7013584	712118	7725702	9.781
2009	38923832	4166334	43090166	3920068	429760	4349828	7013584	712118	7725702	9.906
2010	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.015
2011	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.015
2012	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.015
2013	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.015
2014	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.015
2015	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.015
2016	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.015
2017	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.015
2018	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.015
2019	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.015
2020	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.015

Figure 7. Design-Bid-Build Travel Data for the St. Louis Study Area, Daily Values (2007-2020)

Design-Bid-Build Travel Data

	VMT			VHT			VTT			
Year	AUTO	TRUCK	TOTAL	AUTO	TRUCK	TOTAL	AUTO	TRUCK	TOTAL	VMT/VHT
2007	38900333	4167367	43067700	3537457	387685	3925142	7013584	712118	7725702	10.97226
2008	38898157	4166246	43064403	3727305	347404	4074709	7013584	712118	7725702	10.56871
2009	38898157	4166246	43064403	3727305	347404	4074709	7013584	712118	7725702	10.56871
2010	38898157	4166246	43064403	3727305	347404	4074709	7013584	712118	7725702	10.56871
2011	38898157	4166246	43064403	3727305	347404	4074709	7013584	712118	7725702	10.56871
2012	38898157	4166246	43064403	3727305	347404	4074709	7013584	712118	7725702	10.56871
2013	38898157	4166246	43064403	3727305	347404	4074709	7013584	712118	7725702	10.56871
2014	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.01512
2015	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.01512
2016	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.01512
2017	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.01512
2018	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.01512
2019	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.01512
2020	38903676	4167718	43071394	3523965	386241	3910206	7013584	712118	7725702	11.01512

Values for Figure 6 and 7 were provided by MoDOT by using a regional travel demand model. The baseline regional travel demand model was provided by for this study by East-West Gateway Council of Governments (EWGCOG), the Metropolitan Planning Organization (MPO) for the St. Louis region. Due to time constraints, the baseline model provided by EWGCOG has not been validated.