
# TECHNICAL MEMORANDUM #3: BUSINESS AND PROPERTY OWNER IMPACT LITERATURE REVIEW

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## SUMMARY

As part of the Oregon Department of Transportation's (ODOT) Main Street Safety Project in Springfield, Oregon, ODOT and the City of Springfield contracted ECONorthwest to conduct a literature review of the potential effects possible infrastructure safety solutions for Main Street might have on nearby businesses and property owners. As a small part of the larger evaluation framework[1], the purpose of this literature review is to summarize the potential economic impacts to businesses and commercial property owners from various kinds of possible corridor safety infrastructure solutions.

Redesigning urban arterial streets to improve traffic and safety conditions is a common urban transportation investment strategy. A safety redesign may include a reconfiguration of motor vehicle traffic lanes along with other traffic management measures such as turn restrictions, raised medians, and crosswalks. The primary focus of most arterial redesigns is to improve safety, decrease travel times, and manage traffic speeds. In general, ex-post[2] studies of arterial redesign efforts, which are based on actual results rather than forecasts, confirm such investments often reduce speeds and crashes while increasing typical travel times. The benefits from speed and crash reductions are often found to outweigh, in economic terms, the costs of increased travel times, but these net gains are subject to context-specific factors and conditions and are influenced by average

[1] This refers to the larger framework for evaluating solutions being considered as part of the Main Street Safety Project.
[2] based on knowledge and retrospection and being essentially objective and factual

daily traffic (ADT) levels. A Federal Highway Administration report[3] specifically links such arterial reconfigurations with reductions in crashes and injuries. ECONorthwest reviewed the available literature[4] on the business impacts of access management[5] with a specific focus on identifying studies with an empirical basis. Such studies attempt to measure the direct effect of the redesign on businesses in the form of customer visits or sales information. Ideally, those studies also attempt to control for other factors influencing business performance by collecting information before and after the redesign is implemented and measuring similar business performance in other corridors where no design or operational changes were implemented.

However, there are few studies that attempt to measure the effect of arterial street reconfigurations on retail sales and business performance, and are often survey-based and/or have been implemented in larger cities. Well-designed studies that control for a wide range of factors influencing business performance are difficult and expensive to implement. As a result, rigorous studies on this topic are scarce. Below is a summary of findings from a review of the available literature.

## The Impact of Raised Medians and Roundabouts

A few studies focused specifically on the effects of new raised medians or roundabouts. These studies suggest impacts to businesses will likely not be significant[6] and may be positive overall:

- Businesses near these types of investments performed (in terms of sales) as well as, or better than, their counterparts in corridors where no investments occurred.
- Business owner perceptions of roundabouts are generally positive; stemming in part from the impression of improved traffic flow.
- Business impressions of raised medians appear to be less positive, and harder to shift. Even in cases where sales data demonstrates business performance has improved, businesses perceive the raised medians as a potential impediment to customer and delivery access.

[3] US Department of Transportation - Federal Highway Administration. 2004. "Evaluation of Lane Reduction "Road Diet" Measures and Their Effects on Crashes and Injuries."
[4] See Appendix A.
[5] A suite of strategies that are designed to improve safety and traffic conditions by managing access to properties adjacent to the corridor, including: restricted turn movements, center turn lanes, raised medians, and roundabouts.
[6] Most studies focus on near-term business results (within a year of the investments).

## General Business Impacts

The broader literature on business impacts of access management and arterial corridor redesigns is dominated by before-and-after studies and surveys of commercial businesses about their perceptions of business performance after access management treatments have been implemented. Key findings include:

- Overall, there is no clear indication from the literature that access management, safety projects, and corridor operational investments lead to declines in business performance. To the contrary, there is some evidence that such investments may improve business performance as a result of addressing underlying traffic congestion and safety deficiencies.
- The above finding does not suggest that no single business in a redesigned corridor could experience business losses due to changes in accessibility. There is some evidence that businesses in mid-block locations may be more susceptible to lower customer visitation as a consequence of access restrictions (restricted turn movements, limitations in sight lines, etc.). Also, businesses that more heavily rely on pass-by traffic (where the business is not a primary customer trip destination) may be affected by access restrictions should their business become less accessible to pass-by traffic.
- Some literature suggests business losses during construction may be the primary negative effect on business performance. However, such construction impacts would occur from any corridor re-construction, independent of the final configuration of the project.
- General urban economic theory[7][8] dictates that should street investments change business site accessibility and gross sales, those changes should eventually be captured in the value of the underlying property as opposed to the profitability of a specific business[9]. So while changes in land values may be observed, those changes may not indicate business gains or losses in terms of sales or profits.
- Finally, investments that change how individual corridors perform, and influence business site accessibility within those corridors, are unlikely to have any influence on the broader regional economic productivity. As site values in the affected corridor change, they do so relative to site values elsewhere in the broader urbanized area.

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[7] Der Isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie, oder Untersuchungen über den Einfluss, den die Getreidepreise, der Reichtum des Bodens und die Abgaben auf den Ackerbau ausüben, Vol. 1

[8] Weber, Alfred “Theory of the Location of Industries”, Translated in 1929.

[9] As site accessibility improves property owners will adjust lease rates until business profits return to what are considered “normal” economic profits. This in turn may result in business turnover, or other business adjustments. The time frame for such adjustments is subject to many local conditions, contractual commitments, and market constraints.

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# INTRODUCTION AND PURPOSE

As part of the Oregon Department of Transportation's (ODOT) Main Street Safety Project in Springfield, Oregon, ODOT and the City of Springfield contracted ECONorthwest to conduct a literature review of the potential effects that the range of possible infrastructure safety solutions for Main Street might have on nearby businesses and property owners. In this memorandum, we[10] summarize the findings from a literature review of existing studies about the business impacts of street design changes that influence how businesses are accessed within commercial corridors.

The purpose of the Main Street Safety Project is to select infrastructure solutions that will make Main Street safer for people walking, biking, driving, and taking transit. The selected safety improvements will provide for the movement of goods and people, support the economic viability of the corridor, accommodate current bus service and future transit solutions, and complement safety education and traffic enforcement. This memorandum focuses on only a small subset of those objectives: the potential impacts to corridor businesses from street redesigns (such as roundabouts or medians) that may impose restrictions on vehicle movements.

This literature review is intended to contribute to the general understanding of potential economic impacts to businesses from various kinds of corridor safety infrastructure solutions, and in this manner is only a small part of a larger evaluation framework.

# METHODS

In our review of literature, we sought evidence of the link between street redesign and business performance by focusing on the literature that reflected best practices in research design. An ideal analysis would isolate the effects of a policy or action by controlling for changes in factors unrelated to the policy or action of interest. This ideal is rarely achieved. Often, the many other factors that influence the outcome of business impacts cannot be isolated given available analytical tools and budget constraints. In the social sciences, the "gold standard" for experiments includes all of the following elements:

- An examination of results from settings with and without the policy or "treatment" (in other words, an experimental case and a control case).
- An examination of results both before and after the policy or "treatment" is applied.
- The collection of data that represents revealed behaviors.

In cases where the above conditions are not practical, selected features of the ideal analysis may be retained while others are abandoned. For example, it is common for before and after studies to be performed when the

[10] Throughout this memo, the terms "we," "our," and "us" refer to Matthew Kitchen, Ryan Knapp, and Emily Picha at ECONorthwest <http://www.econw.com/>.

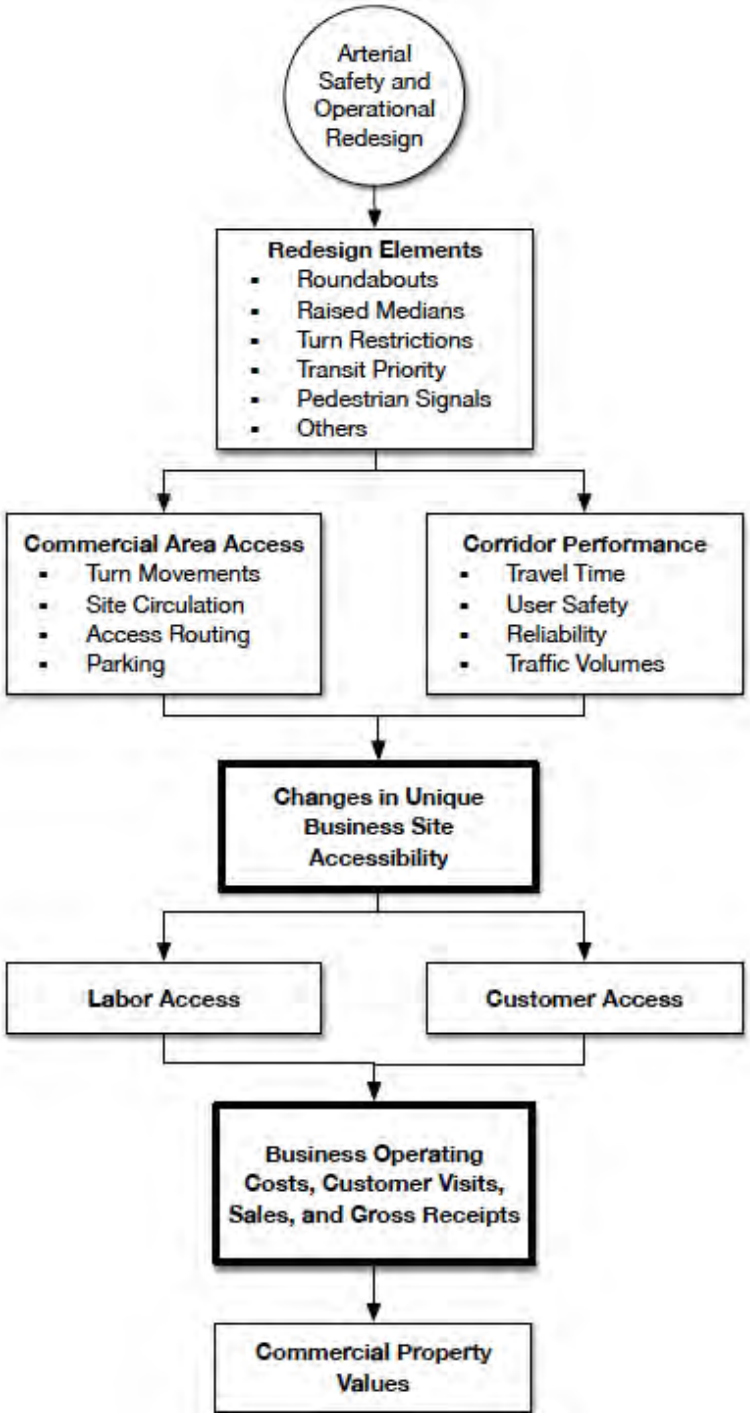
researcher finds it is not feasible to identify a suitable control condition. In other cases, researchers use carefully designed survey methods in lieu of revealed preferences (or purchasing behavior) to understand perceptions, preferences, and other qualitative factors that help establish general magnitudes or relative magnitudes of effects.

In our review of the available literature, we have looked for evidence of the means by which corridor safety and redesign projects (as characterized in more detail below) have effects on business performance.

## FACTORS THAT INFLUENCE BUSINESS IMPACTS

Figure 1 is a diagrammatic representation of how street redesigns influence business performance. Street redesign investments change the performance of a corridor as well as dictate how vehicles, bicyclists, and pedestrians access specific business sites. These changes in accessibility are unique to each business location.

**Figure 1: Street Redesign, Changes in Site Accessibility, and Business Performance**




*Source: ECONorthwest*

The above diagram shows employees, vendors and service providers and customers must access business sites during the normal course of business, and changes in accessibility will influence their willingness to do so. Changes in customer visits ultimately translate to changes in spending, business gross receipts, and profits. As individual sites become more or less profitable to businesses (due to the changes in accessibility), some or all of the changes in profitability will be captured in the underlying value of the property.

Businesses choose locations that support their primary operational objectives. Employees must access business locations to perform their work tasks, and businesses with a strong customer focus (e.g. retail) choose locations that maximize their exposure to customers. Business accessibility operates at multiple geographic scales. Businesses care about broad access to their customer and labor markets (regional and sub-regional location), the performance of transportation infrastructure that provides connections to the business location (corridor location relative to final markets), as well as specific details of site accessibility (turn movements, site circulation, driveways, parking and transit stop locations). At specific sites, businesses make tradeoffs about these factors of accessibility. Traffic capacity, speeds, and reliability at one location may come at the expense of parking capacity, or a larger customer catchment area may be associated with more traffic congestion and slower arterial speeds. Different businesses (types and sizes) will have different preferences, and different willingness to pay for or accommodate various accessibility factors.

In the context of the Main Street Safety Project, there are substantial safety concerns associated with the current roadway configuration. Like many communities, Springfield is considering a redesign of the corridor to meet broad community objectives of increasing safety, supporting the vitality of the community and its vision for Main Street, and creating a multimodal environment that connects people and destinations. Communities consider an array of facility improvements, including:

- turn restrictions;
- driveway consolidations;
- raised medians;
- pedestrian crossing controls; and
- roundabouts.

Arterial redesign efforts may focus on supporting people walking, biking, and taking transit, or may emphasize improving safety, while at other times the emphasis is on traffic calming, or a combination of all three. Independent of the focus, specific features of an arterial redesign will influence **how properties are accessed** and also have some impact on how the broader **corridor performs in terms of traffic volumes, speeds and reliability.**

There are several types of businesses that will have unique needs, including:

- **Destination businesses** are businesses with a customer base familiar with the business and seeking its location as a destination. These businesses will be concerned about the general performance (e.g. travel speeds and perceived safety) of the transportation infrastructure.
- **Opportunity businesses** are businesses that rely on incidental patronage by customers passing by and will also be concerned about other, very localized, factors such as business visibility, ease of access to the specific site, parking, pedestrian accessibility and amenities.

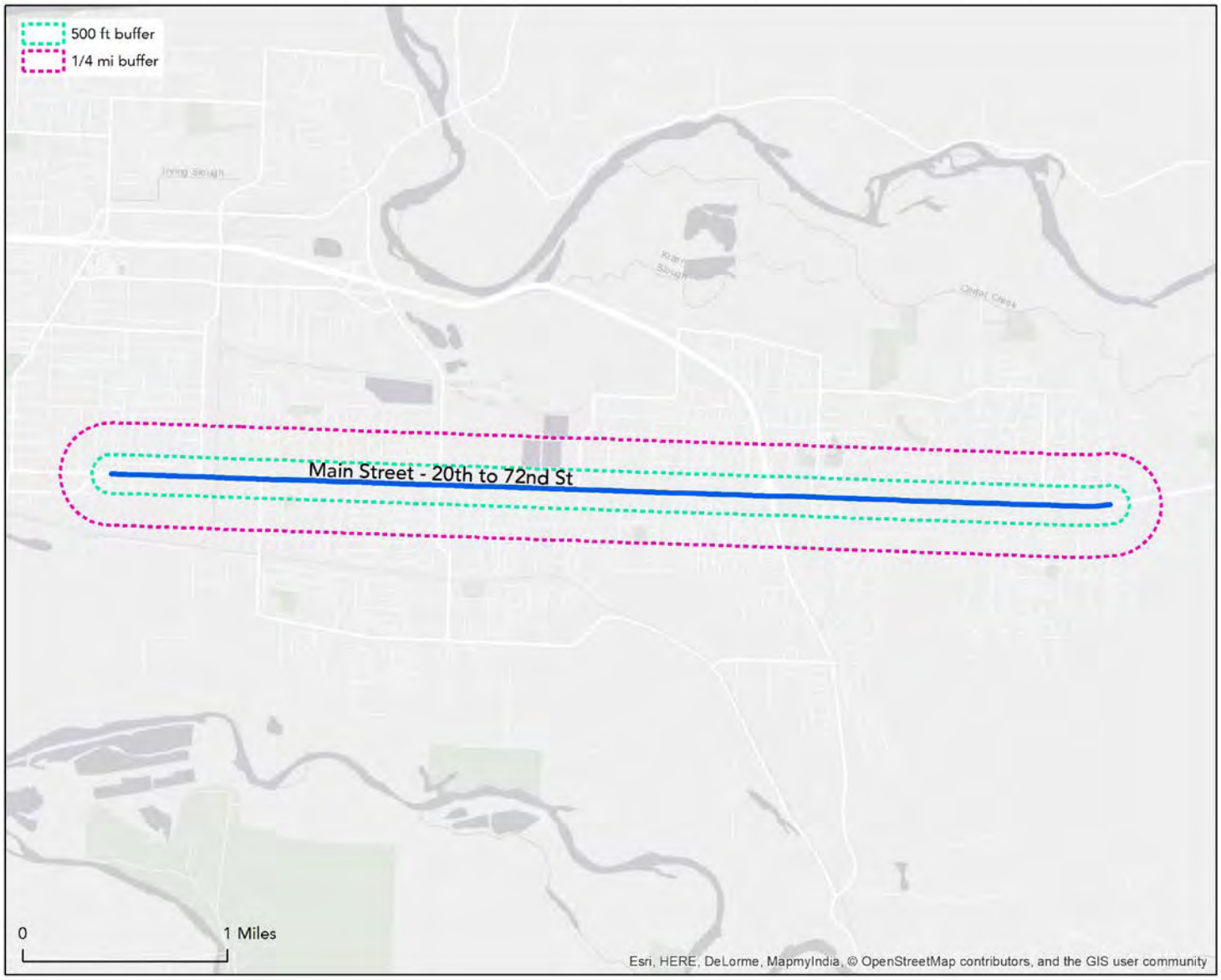
For any business, the general logic is the same: the higher the level of accessibility to a business, the more customers there are who may patronize that business, and the more easily businesses manage total transportation costs of their supply chain. Additional customers translate to additional business revenue and owner and employee income. However, if a specific location is made more accessible (or less), that location, or site, will eventually command higher (or lower) rents in the real estate market. In this manner, higher business revenue will, in part, translate into higher lease rates, and not entirely be associated with higher business profits. This final point is important – in competitive markets, any unique value associated with the characteristics of a specific parcel of land will eventually accrue to that land in the form of higher land values. Businesses that own the land upon which they are located will see direct gains or losses from changes in accessibility. Businesses that lease or rent their locations may, or may not, enjoy the benefits from changes in accessibility. This means that transportation's influence over business performance is in part determined by whether the business owns the property on which it operates.

## EXISTING BUSINESS MIX

Within the Springfield Main Street corridor, ECONorthwest acquired Quarterly Census of Employment and Wages (QCEW) data to support the development of an inventory of existing businesses[11]. We summarized employment and average wages by business category[12] within a quarter mile buffer of the Main Street corridor, as well as for a 500-foot buffer designed to capture businesses most directly affected by the corridor redesign. The larger buffer captures businesses likely impacted by accessibility from Main Street, while the smaller buffer captures businesses most impacted by visibility from the Main Street corridor. Figure 2 displays the corridor and the buffer geographies.

[11] This process examines only the existing inventory of businesses in the corridor and does not reflect any expectation of future business mix.
[12] Categorization of businesses are limited by non-disclosure requirements placed upon the distribution of QCEW data.

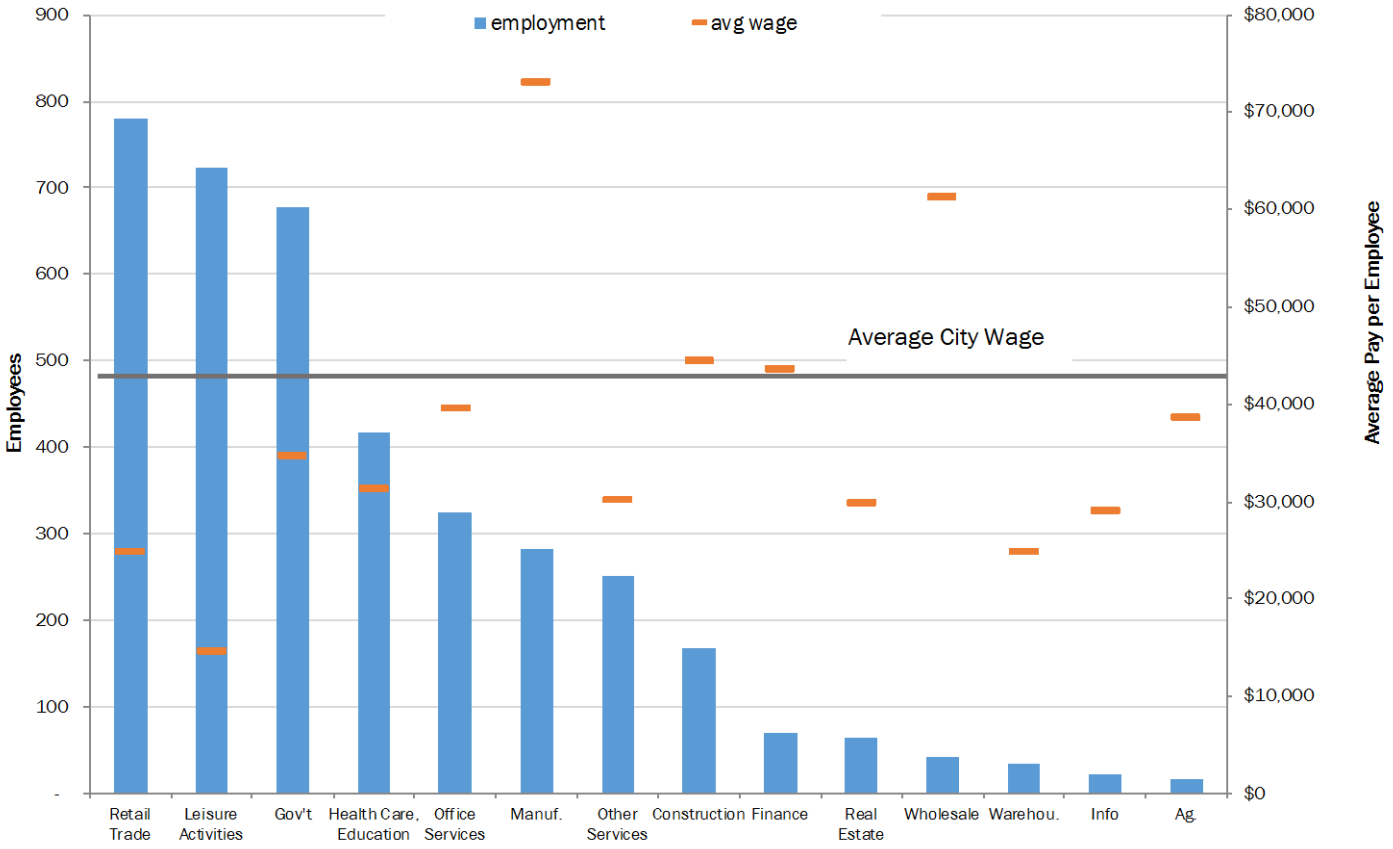
**Figure 2: Springfield Main Street Business Mix Study Area**




*Source: ECONorthwest*

Within a quarter mile of the Main Street corridor, there are 418 businesses employing 3,789 persons (14% of the citywide total employment). Total payroll in this area is 10% of the citywide total. Retail and leisure activities constitute about a quarter of the buffer area businesses and 40% of the area employment. Other primary employment sectors include government, healthcare, private education, and office services. Figure 3 displays employment and average wages by business category within the quarter mile buffer.

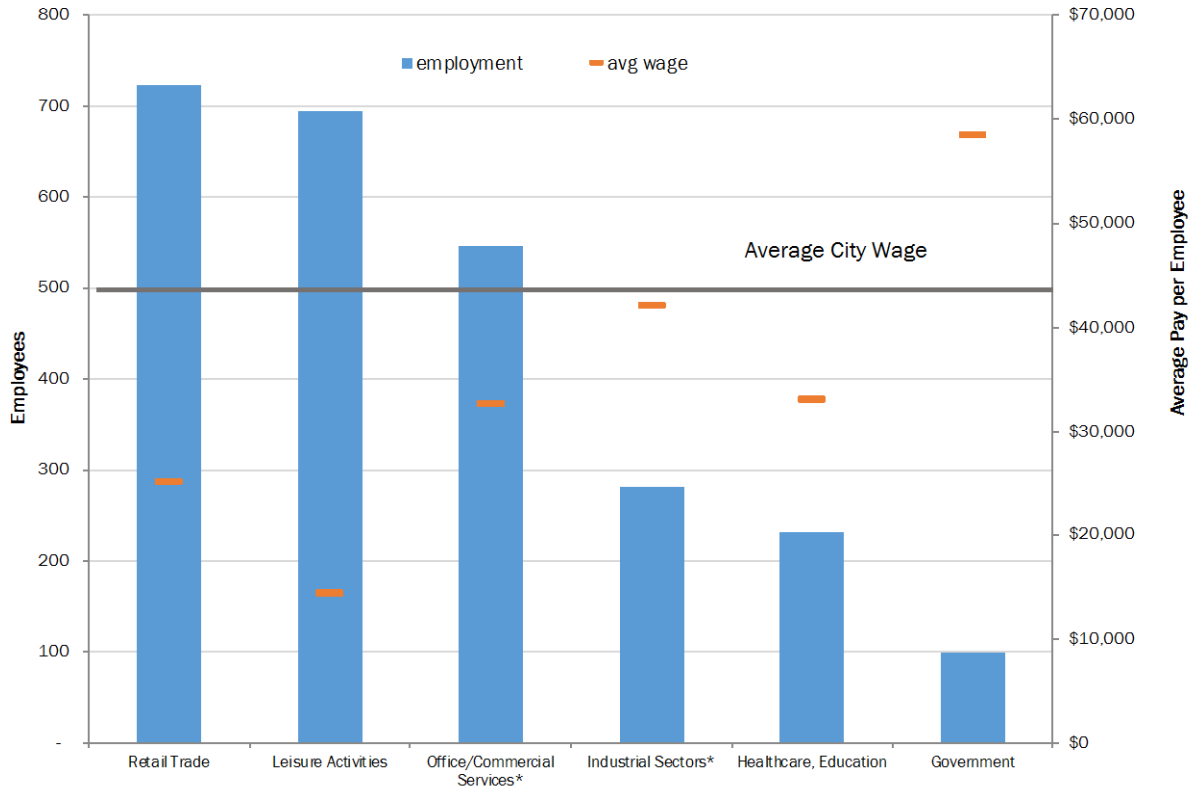
**Figure 3: Employment and Wages by Category within ¼ Mile of Main Street**




*Source: ECONorthwest, Oregon Department of Employment, and Quarterly Census of Employment and Wages Data*

Within the 500-foot buffer of the Main Street corridor, there are 282 businesses employing 2,577 persons (9% of the citywide total employment). Total payroll in this area is 6% of the citywide total. Retail trade and leisure activities constitute about a third of the buffer area businesses and 55% of the area employment. Other primary employment sectors include office services, healthcare, private education, and government. Figure 4 displays employment and average wages by business category within the 500-foot buffer.

**Figure 4: Employment and Wages by Category within 500 Feet of Main Street**




*Source: ECONorthwest, Oregon Department of Employment, and Quarterly Census of Employment and Wages Data.*
**ECONorthwest grouped businesses in several sub categories into the Office/Commercial Services and Industrial Sectors due to confidentiality requirements for the data.*

The inventory of current businesses confirms that those businesses (e.g. retail and leisure activities) most dependent on incidental passer-by customers self-select for business locations that are most visible and accessible (within the 500-foot buffer) to the arterial traffic. Those businesses are likely most susceptible to changes (both positive and negative) in business access that may result from redesigning the Main Street corridor.

# BUSINESS IMPACT OF SPECIFIC INVESTMENTS

## Medians

Raised medians serve to control access to commercial properties by restricting left turn movements to select locations. Various turn movement configurations can be provided. The potential benefits from raised medians

are overall traffic flow in the corridor can be improved and intersections can be managed for more efficient movements and lower queueing conditions. If the general efficiency of the corridor allows for more volume of traffic, then businesses in the commercial district should benefit overall. Business concerns arise if restricted turn movements present challenges for vehicles when accessing specific business sites.

Generally, medians with turn restrictions will result in improved performance at controlled intersections (i.e. signalized or roundabouts) and easier access to business sites that are located nearer to those intersections with U-turns available. Access to mid-block business sites could, under certain circumstances, involve more circuitous routing. Paired with roundabouts, raised medians may lead to improved access overall for most business sites within a corridor. In advance of implementation, however, many businesses may be concerned about access restrictions, sharing access points or allowing cross access with adjoining properties for effective circulation. As is true for the general literature, there were just a few specific studies found that involve the exacting standards necessary to provide empirical evidence of how raised medians affect business performance.

South Carolina DOT, researchers[13] studied the sales tax history of businesses in corridors where access management changes ((1) driveway consolidation, (2) providing sufficient corner clearance distance from an intersection, (3) access restriction near signalized intersections, and (4) raised median implementation) were implemented. The six corridors studied had average daily traffic volumes ranging between 17,000 and 37,000[14]. The study used both surveys of businesses and an examination of three years of sales tax records to evaluate the economic impacts of the changes in the corridor. While a majority of the businesses surveyed believe raised medians had a negative effect on customer visits and sales, the analysis of sales volumes indicated that the decrease in sales for the affected businesses was similar to the performance of businesses in the control group.

The Utah DOT sponsored research[15] examining corridors where raised medians were implemented as a safety and access management strategy. The research focused on three arterial corridors and examined before and after implementation taxable sales records. For each study corridor a suitable control corridor was identified. Taxable retail sales (measured both as a gross value and as a value per square foot of building space) in all three corridors increased post implementation of the raised medians. Additionally, all study corridors performed as well or better than the control corridors in terms of growth in retail sales.

In Utah surveys of business's impressions were also conducted. These surveys found businesses in the corridors where raised medians were built had a more negative impression, both pre- and post-construction, of

[13] https://www.scdot.scltap.org/wp-content/uploads/2018/07/SPR-715_Final-Report-6_29_2018_V2-3.pdf
[14] Approximately 20,000 vehicles per day use the Main Street corridor, of which truck traffic accounts for approximately two to four percent.
[15] https://www.udot.utah.gov/main/uconowner.gf?n=4511209509821664

customer access and delivery than did their counterparts in corridors where no raised medians were present. These impressions appeared to be in contrast with the taxable sales data collected during the study, highlighting the challenges associated with addressing strongly held business concerns about potential degradation of business access. A report by Eisele and Frawley found business perceptions of the effects of a new raised median were more negative, even during construction, than the actual effects.[16]

A study of raised medians for Texas Department of Transportation provides useful insights based on extensive application of business surveys across five separate street locations where medians were implemented. Specific findings include:

- Businesses perceived that after implementation of raised medians traffic volumes increased, property values increased, and the frequency of accidents decreased.
- Businesses generally perceived that gross sales increased after installation of medians within the affected corridor.
- Businesses overall perceived that customer visits increased after median installation, however gas stations and auto repair businesses were the exception – perceiving fewer customer visits.

## Roundabouts

As with the case of the broader literature on business impacts of arterial redesigns, the literature on business impacts of roundabouts is limited and qualitative. Two reports[17,18], summarizing a single effort at characterizing how roundabouts impact nearby businesses, involved a combination case study review and business surveys.

> *The study concentrated on the literature, surveys to businesses, and case studies that showed roundabouts' ability to move traffic more efficiently. Conclusions were based on the widely accepted assumption that businesses and business areas that have good vehicle and pedestrian access and traffic flow should prosper and grow and, conversely, businesses that do not have good access and good traffic flow will not.*

No empirical information on business performance was included in these reports, but rather survey tools were used to capture business impressions of their own performance across a number of locations throughout Kansas as well as Carmel, Indiana. Survey responses from nearby businesses were generally positive about roundabouts. Traffic simulation of converting a number of intersections in the Topeka business area to

[16] Eisele, William and William Frawley. 2000. "A Methodology for Determining Economic Impacts of Raised Medians: Final Project Results." Texas Transportation Institute, Texas A & M University System.
[17] Godavarthy, R. P., Mirzazadeh, B., Russell, E. R., and Landman, D. 2016. "Roundabout's Impact on Nearby Businesses". Journal of Transportation Technologies, 6, 181-191.
[18] Russell, E. R., Landman, D., and Godavarthy, R. P. 2012. "A Study of the Impact of Roundabouts on Traffic Flows and Business." Kansas State University Transportation Center; Report No. K-TRAN: KSU-09-10

roundabouts confirmed substantial traffic flow benefits in the form of less vehicle delay and queueing at intersections. Based on this combination of findings, it was concluded that roundabouts have a positive impact on traffic flows and business activity. Without empirical substantiation, however, these conclusions must be considered qualitative. And the pairing of roundabout and raised medians may offer opportunities to provide good access to corridor business. This facility type also allows for reduced corridor cross-section width associated with wider turning movements at signalized intersections, thus preserving space for parking, circulation and business frontages.

## BROADER LITERATURE ON BUSINESS IMPACTS OF ACCESS CHANGES

The relationships between traffic, traffic congestion, and economic performance are well documented. Street reconfigurations may affect business bottom lines in several ways: longer queues and slower travel times may lead some consumers to opt for a more accessible alternative; longer travel times and narrower lanes may make it more expensive for delivery trucks to deliver goods to a business and thereby increase the cost to the business; and traffic delays may increase the cost incurred by employees when traveling to work. As a result, street reconfigurations may lead to changes in transportation costs, which could change the cost of production and the quantities produced.[19] Alternately, road reconfigurations designed to improve access and safety may result in overall improved performance of the corridor in terms of speeds and travel reliability. There are a couple of key conclusions from the literature:

- Business location and performance are linked to transportation costs, which is consistent with the basic principles of location theory.[20,21] In the case of retail businesses, transportation costs are borne in part by customers as they access retail businesses.[22]
- Researchers of Chicago and Philadelphia found that traffic congestion shrinks business market areas and reduces the chances of “agglomeration economies,” in turn raising production costs. This research,

[19] The economic literature on this topic is summarized in Goodwin, Phil. 2004. "The Economic Costs of Road Traffic Congestion." *ESRC Transport Studies Unit – University College London.*

[20] Thünen, Johann Heinrich von. 1783–1850. *Der Isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie, oder Untersuchungen über den Einfluss, den die Getreidepreise, der Reichtum des Bodens und die Abgaben auf den Ackerbau ausüben, Vol. 1,.* and *Der Isolierte Staat..., Vol II: Der Naturgeässe Arbeitslohn und dessen Verhältnis zum Zinsfuss und zur Landrente, Part 1* (Partial translation into English by Carla M. Wartenberg in 1966 as *Isolated State.* New York: Pergamon Press.)

[21] Weber, Alfred. 1929. (translated by Carl J. Friedrich from Weber's 1909 book). *Theory of the Location of Industries*. Chicago: The University of Chicago Press.

[22] Hotelling, Harold. 1929. “Stability in Competition.” The Economic Journal, 39 (March), 41-57.

however, looked at large-scale, highway traffic congestion as opposed to increased traffic on a single, urban arterial street like Springfield's Main Street.[23]

The general framework that treats transportation costs as an input into the production process is the basis for understanding the potential economic consequences of adopting arterial redesigns. If an arterial redesign impedes travel times for people driving then shoppers who travel by car may choose to patronize an alternative, more car-accessible retailer. Likewise, the accessibility of driveways through left turn lanes may increase visits to businesses. The direct empirical evidence for these effects on business performance is impeded by the challenges associated with accurately measuring the cause and effect of business performance given all the many other factors that contribute to business performance over time.

A few studies use sales tax data to try to measure the effect of arterial reconfigurations on retail performance. For example, recent research in New York City attempted to develop new metrics to measure the economic impacts and effects of street reconfigurations. These studies found that protected bike lanes, dedicated bus lanes, and other traffic reconfigurations were positively associated with sales tax revenues and negatively associated with commercial vacancies.[24] Oregon, unfortunately for research purposes, does not have sales tax data with which to complete this type of research.

The empirical evidence for access management effects on traffic and safety has been systematically documented in the engineering literature. There is strong evidence from the literature that access management projects can produce safety benefits. The magnitude of these traffic and safety effects is typically modest for urban arterials with less than 20,000 ADT.

There is also evidence that supports the use of access management as a tool for traffic flow management, improving speeds and reliability, but results are highly context- and design-specific. Traffic flow benefits may come with or without overall reductions in ADT. The specific design of intersections and management of turn movements will have an influence on traffic patterns.

Adjusting infrastructure and amenities for people who walk and bike may change visits from pedestrians and bicyclists. There is some evidence that walk and bike trips are associated with different business patronage and spending behavior than is associated with vehicle trips. In a number of studies bike and walk trips are associated with more frequent business patronage but with smaller per trip expenditures[25].

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[23] Weisbrod, Glen et al. 2003. "Measuring Economic Costs of Urban Traffic Congestion to Business." *Transportation Research Record: Journal of the Transportation Research Board* 1839, no. 1.
[24] New York City Department of Transportation. 2013. "Measuring the Street: New Metrics for 21st Century Streets."
[25] In these studies per visit expenditures declined but frequency of visits increased leading to comparable total expenditures per patron independent of mode of access.

If automobile ADT is reduced by an arterial reconfiguration or implementation of access management policies, then visits to retailers along the street may also be reduced. Retailers may, however, sustain visits if ADT reductions are primarily amongst through-travelers or in the case where ADT reductions are matched by increases in bicycle and pedestrian visits[26].

## Access Management Changes

The implementation of access management strategies that support roadway and safety improvements, (such as speed zone changes that succeed in reducing observed travel speed, channelization, turn restrictions, and driveway consolidation) are increasingly common arterial street design elements in urban and suburban commercial settings. The primary objectives of the collection of access management strategies are to improve safety and traffic operations. The literature related to how property accessibility and access management directly influence business performance is limited by the challenge of isolating cause and effect associated with business performance.

A report prepared for the Washington State Transportation Commission examined the relationship between business perceptions of access management and business perceptions of their own performance.[27] Findings from this study include:

- Retail services[28] establishments are less inclined than other retail establishments to perceive a relationship between access management and business performance.
- Businesses that already have good access from the main corridor are more likely to perceive a relationship between access restrictions and business performance.
- Larger businesses (more than 10 employees) are more likely to perceive a relationship between access management and business performance. Larger businesses are also more likely to be concerned about access restrictions.
- Two-way turn lanes, as compared with factors that directly affect site accessibility, such as turn restrictions and driveway removals, are not perceived to have an influence on business performance.
- The overall level of congestion within the corridor is perceived to be a more influential factor for business performance than site accessibility and access management.

[26] This memo makes not claims about future trips, or model shares of trips after safety improvement are implemented.
[27] Vu, Patrick et al. 2002. “Economic Impacts of Access Management.” Washington State Department of Transportation and TRAC.
[28] Retail services are businesses with a retail customer orientation classified as part of the services sector.

A national study of left turn restrictions was conducted for the National Cooperative Highway Research Program[29] and examined the economic effects of restricting left turns using survey methods and empirical based sales and revenue data from 9,200 businesses. The study found:

- *Gas stations, non-durable goods retailers, and service businesses appear to be the most likely to be adversely affected; where restricted, these businesses showed the largest sales declines, and the highest rates of business failures. By contrast, grocery stores and restaurants appeared to benefit from the restrictions, showing increased sales and decreased business failures.*
- *The survey and interview results present a mixed picture. In some instances, business owners believed that the left-turn restrictions reduced access to their stores and resulted in lost business. In other cases, business owners reported the turn restrictions decreased congestion and improved traffic flow to the point where their market areas actually expanded. These business owners felt that customers were traveling to their stores from farther away than prior to the restrictions.*
- *Businesses at mid-block locations (i.e., away from intersections) perceived the left-turn restrictions as more detrimental than did businesses at intersections or other points where left turns were permitted. In some cases, left turn restrictions appeared to cause a portion of sales to shift from the restricted to the unrestricted business locations within the study corridor.*

For the North Carolina Department of Transportation, a research team undertook survey-based research[30] on the effects of access management on North Carolina businesses. The team surveyed nearly 800 businesses located in “treatment” sites as well as “control” sites (similar locations where no access management treatments had been implemented). The research coincided with the 2007-09 economic recession within the state and the nation as a whole, so attempts were made to control for the broader economic conditions. The study concluded:

- There was no statistically significant difference in self-reported revenue changes between comparison and treatment sites, even when looking at individual treatment/comparison pairs.
- Within the treatment site locations over 70% of businesses felt that traffic conditions had improved or stayed the same as before the access management installations. And businesses in treatment site responded more favorably than control site businesses to questions of safety, traffic operations, and business access.

[29] NCHRP Project 25-4, "*Economic Effects of Restricting Left Turns*.” Mr. Glen E. Weisbrod and Ms. Roanne Neuwirth.
[30] Cunningham, C., Schroeder, B., Findley, D., Foyle, R., Katz, D., Smith, S., Carter, D., and Miller, M. 2010. *Economic Effects of Access Management Techniques.* The Institute for Transportation Research and Education; NCSU.

A study[31] for the Iowa Department of Transportation studied three access management treatment sites in Iowa to understand how traffic, safety and business vitality were affected. Business trends at the treatment sites were compared with other similar commercial settings where no access management treatments were implemented:

- The case studies showed that access management projects are rather benign in terms of business impacts. Access managed corridors generally had lower rates of business turnover than other areas of their communities. They had more rapid growth in retail sales once projects were completed. Far more business owners, when surveyed, indicated that their sales had been stable or increased following project completion than reported sales losses.

## Before and After Studies

Most studies of arterial reconfigurations focus on the traffic statistics on a stretch of road before and after implementation. And some studies attempt to describe the effects the arterial redesign had on business performance or economic conditions if all other things are held constant.

In one study, qualitative and quantitative data allowed researchers to determine the effects from arterial reconfiguration on York Boulevard in Los Angeles. They found that there were no “meaningful linkages between the presence of a road diet and changes in economic conditions.”[32]

A report on the performance of Main Street in Ashland, Oregon found that the road reconfiguration outperformed what was projected in terms of traffic speeds, queue lengths and intersection Level of Service (LOS) and in many instances represented an improvement over the baseline conditions. [33]

Stantec collected economic data of businesses along two corridors in downtown Vancouver, BC where single bike lanes were converted to separated bike lanes[34]. In each case, business owners reported reductions in sales (-10%, -4%) and customers reported similar reductions in visits to the area. The reasons customers reported for the reductions were traffic congestion, less parking, turning restrictions, and reduced pedestrian safety.[35] The dense Vancouver downtown area is likely not directly comparable to Springfield Main Street but this study does illustrate the potential relationship between traffic volume, arterial design and business impacts.

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[31] Maze, T. and Plazak, D. 1999. *Access Management Research and Awareness Program Phase IV Final Report*. Iowa Department of Transportation. CTRE Management Project 97 -I, University of Iowa.
[32] McCormick, Cullen. 2012. "York Blvd: The Economics of a Road Diet." University of California Los Angeles.
[33] Faught, Mike. 2013. "Re: Post Road Diet Assessment - January through October." City of Ashland - Public Works.
[34] To implement the separated bike lanes, road space was reallocated, parking spaces were moved or eliminated, the illegal use of some loading zones was eliminated, and turning restrictions were introduced.
[35] Stantec Consulting ltd. 2011."Vancouver Separated Bike Lane Business Impact Study."

A Vancouver, WA study[36] attempted to describe the economic impacts or effects of the arterial redesign project. The Vancouver study found that businesses along the redesigned street "faired [sic] no worse than its peer areas" in 2002-2003, when the city experienced a general recession. The reconfigured Fourth Plain Street had a 4.7% decrease in "taxable retail sales" compared to 9.8% and 25.0% reductions at two comparison commercial zones. The two customer complaints to the city that referred to the reconfiguration concerned traffic signal timing.

## Case Studies

Much of the literature found detailing business effects from arterial redesigns was case studies. These case studies depicted robust business and job growth in relation to arterial redesign efforts.

A cautious conclusion of these largely positive case study results is that investments in arterial reconfigurations can been shown to be part of broader area development initiatives that have ultimately led to more localized economic activity. Urban economies are complex and dynamic environments. An increase of jobs and businesses after the implementation of a street investment does not, by itself, give any indication of how much of that increase is attributable to any one specific investment. In addition, many of the case studies focus only on post-implementation benefits (e.g., new jobs or sales) and fail to describe the net benefits (is the value of the benefits greater than the value of the costs). While case studies are excellent tools to confirm or challenge a theory, or to investigate phenomenon with limited literature,[37] only limited generalization of their results into implementable policies can be supported.

In Barracks Row, Washington D.C., District Department of Transportation "made $8 million public investment in streetscape improvement in 2003–2004. [Through 2005], and an additional $8 million in private investment has been made in the corridor. Thirty-two new business establishments, including nine new outdoor cafes, have opened since the completion of the street enhancements and private investments have been completed."[38]

In Lancaster Boulevard in Lancaster, CA, after a nine-block revitalization project, the area saw "50 new businesses" and "800 new jobs."[39]

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[36] 2004. "Nickerson Street Rechannelization before and after Report."; City of Orlando - Transportation Planning Bureau. 2002. "Edgewater Drive before & after Re-Striping Results."; City of Vancouver - Transportation Services, "Fourth Plain Boulevard Demonstration Re-Striping Project - Post Implementation Report."

[37] Tellis, W. 1997. "Application of a Case Study Methodology." *The Qualitative Record* 3 (3).

[38] Transportation Research Board. 2006. *Linking Transportation and Land Use*. Transportation Research Circular, Number E-C100.

[39] National Complete Streets Coalition. 2013. "The Many Benefits of Complete Streets."

In San Diego, after complete street initiatives, "a survey of tax receipts among 95 businesses along the corridor showed a 20 percent boost in sales. Numerous new businesses opened during construction, including a CVS with a 40-year lease[40]"

A recent study found that pedestrian and bicycle infrastructure projects created more design and construction jobs than automotive-focused projects, as pedestrian and bicycle projects have a higher labor intensity (the ratio of labor to capital).[41] [42]

We found no studies that tried to document a link between arterial redesigns and changes in regional incomes, or regional production. Such changes are a standard measure used by economists to measure the performance of a regional economy.

## Surveys and Opinion Research

Other studies attempt to understand business's performance through the use of business or consumer surveys. Surveys can be used to understand a respondent's impressions of the usefulness of street improvements, business performance, and consumer behavior.

- A survey study of North Main Street in Ashland found that ¾ of businesses said that the road reconfiguration had no effect on their business. The majority of the remaining ¼ mostly reported that deliveries to their location were negatively affected.[43]
- Eisele and Frawley found that business perceptions of what the effects of a new raised median improvement would be before the addition were larger than the actual effects of the new median.[44]
- A survey study completed in the Portland, OR area found cyclists spent more than automobile consumers at restaurants, drinking establishments, and convenience stores. Motorists spent more than cyclists at supermarkets.[45]
- Survey research completed in New York's East Village found that pedestrians and cyclists spent more per capita per week than motorists.[46]

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[40] McCann, B, A Meyer, J Wood, C Morfas. 2012. *It's a Safe Decision: Complete Streets in California*. National Complete Streets Coalition, Local Government Commission.
[41] Garrett-Peltier, Heidi. 2011. *Pedestrian and Bicycle Infrastructure: A National Study of Employment Impacts*. Political Economy Research Institute, University of Massachusetts, Amherst.
[42] Some jurisdictions prioritize job creation, and would see this as benefit. Others would see the additional jobs as an additional cost. In either case, these results are primarily distributional.
[43] Faught, Mike. 2013. "Re: Post Road Diet Assessment - January through October." City of Ashland - Public Works.
[44] Eisele, William and William Frawley. 2000. "A Methodology for Determining Economic Impacts of Raised Medians: Final Project Results." Texas Transportation Institute, Texas A & M University System.
[45] Clifton, Kelly et al. 2013. "Consumer Behavior and Travel Mode Choices." Oregon Transportation Research and Education Consortium.

- A survey study of Polk Street in San Francisco found that motorists spent more per trip, but pedestrians and cyclists spent more per week by taking more trips to retailers than drivers.[47]

There is also some qualitative evidence of increased consumption after arterial reconfigurations.[48] In several surveys, merchants who operate businesses in areas with arterial reconfigurations report that complete street-type policies had improved their bottom lines—although these feelings were not unanimous.[49] Consumers may respond to improved urban streetscapes by viewing stores and products more positively, traveling and staying longer at stores, and by being willing to pay more for parking and products.[50] A study that moved from the hypothetical behavior of surveys to observed behavior relating to street improvements in New York City found that "assessed collectively, street improvement projects do not detract from commercial activity at the site of implementation. They may contribute positively."[51] This study, however, did not answer whether these contributions were net increases or re-distributions from other locations.

## PROPERTY ACCESS, BUSINESS PERFORMANCE, AND PROPERTY VALUES

Transportation investments influence property values as a result of changing the costs of accessing property. Property gets its value from being accessible to economically valuable activities that take place on that property. Arterial reconfigurations that address existing traffic congestion and safety deficiencies can reduce transportation-related costs for customers and employees as they access business sites. Lowering the costs of accessing property, all else being equal, will eventually translate into higher property values. Similarly, specific access management strategies may improve overall corridor performance even while restricting access to specific businesses. It is this complex interplay of factors, along with other factors in the broader economy that makes identifying the specific contribution to property values from changes in accessibility difficult to isolate.

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[46] Transportation Alternatives. "East Village Shoppers Study."
[47] San Francisco Municipal Transportation Agency. 2013. "Polk Street Intercept Survey Results."
[48] See, for example, the case studies of Transportation Research Board. 2006. *Linking Transportation and Land Use*. Transportation Research Circular, Number E-C100.; National Complete Streets Coalition. 2013. "The Many Benefits of Complete Streets."; Bleier, A, K Ferrier, A Hamilton, G Konar, B Peterson, D Sorenson, and S Torma. 2012. *Implementing Complete Streets in the San Diego Region*. American Planning Association, WalkSanDiego.
[49] Drennen, E. 2003. *Economic Effects of Traffic Calming on Urban Small Businesses*. Department of Public Administration, San Francisco State University.; Forkes, J and NS Lea. 2010. *Bike Lanes, On-Street Parking and Business - Year 2 Report: A Study of Bloor Street in Toronto's Bloor West Village*. Clean Air Partnership.
[50] Wolf, KL. 2005. "Business District Streetscapes, Trees, and Consumer Response." *Journal of Forestry* 103 (8): 396-400.
[51] Lee, ES and B Sprung. 2013. *Bike and pedestrian street improvements and economic activity in NYC*. State Smart Transportation Initiative, New York City Department of Transportation.

There are case studies that demonstrate investments in access management and streets redesigned for safety and efficiency increase property values,[52] but the analysis tends to be simple before-and-after studies, with little control for other causal variables. Many studies are specific to pedestrian and transit accessibility. A report[53] cited often examined the relationship between the sale prices of houses and their walk scores[54] in 15 different cities; after controlling for housing and neighborhood characteristics, the study found property values rose with walkability. One needs to be careful, however, about inferring arterial reconfigurations that improve walkability will increase property values. Such studies seldom control for self-selection or account for other factors contributing to both walkability and property values.

Improving transit and walk accessibility will not yield benefits uniformly in all settings. For example, making a five-lane road servicing commercial strip more walkable may have little effect on walking, transit, and auto travel, while making a desirable shopping district more walkable could raise property values. Ultimately, if people demand various street amenities (bicycle infrastructure, street trees, setback sidewalks, traffic calming), then we would expect properties served by these streets to have somewhat higher property values when compared to properties that are other-wise identical but served by a less complete transportation system.

One study found that when traffic calming restraints reduced vehicle volume by several hundred per day, property values increased by 18% on average.[55] Other studies have found similar results.[56] Similarly, several studies suggest consumers are willing to pay more for properties that are walkable, low-traffic, quiet, have bicycle infrastructure, etc.[57] Some analyses make inferences about the unique effects of complete streets difficult by not controlling for other public funding.[58]

While the literature on the property value impacts of street redesigns is modest, general urban economic theory dictates that should investments change business site accessibility and gross sales, those changes should eventually be captured in the value of the underlying property rather than the profitability of a specific

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[52] See, for example, National Complete Streets Coalition. *Complete Streets Spark Economic Revitalization*.; Rush, N, L Actman, P McMahon, H Renski. *Street Redesign for Revitalization: West Palm Beach, FLA*. Accessed June 27, 2013, from http://pedbikesafe.org/PEDSAFE/casestudies_detail.cfm?CM_NUM=5&CS_NUM=16; National Complete Streets Coalition. *Economic Development*. Accessed June 26, 2013.

[53] Cortright, J. 2009. *Walking the Walk: How Walkability Raises Home Values in U.S. Cities*. CEOs for Cities.

[54] A "walk score" is one index of walkability. It awards points based off the distance between a property and nearby destinations. Shorter the distances produce higher the walk scores, and, as the logic goes, greater walkability. For more information, see http://www.walkscore.com/methodology.shtml

[55] Bagby, DG. 1980. "The Effects of Traffic Flow on Residential Property Values." *Journal of the American Planning Association* 1: 88-94.

[56] Litman, T. 1999. *Traffic Calming Benefits, Costs and Equity Impacts*. Victoria Transport Policy Institute.

[57] Synder, R. *The Economic Value of Active Transportation*.

[58] See, for example, *Street Redesign for Revitalization: West Palm Beach, FLA*. Accessed June 27, 2013, from http://pedbikesafe.org/PEDSAFE/casestudies_detail.cfm?CM_NUM=5&CS_NUM=16.

business[59][60]. But if consumers shift demand toward properties on redesigned streets, property values elsewhere must decrease. Additionally, increases in property values are a mixed bag: a benefit to some, a cost to others. Increased property values are a benefit to landowners, but would be a cost to currently operating businesses, that do not own the underlying property, in the form of higher lease rates.

## DESIGN IMPLICATIONS

The arterial redesign literature is largely silent with respect to guidance on specific design implications that will minimize impacts to nearby businesses. There is clearly a potential trade-off between various arterial performance objectives such as safety and site accessibility. Achieving other performance objectives while minimizing any accessibility restrictions to properties will be most likely to support business visibility and accessibility. In other words, business performance is tied to the general transportation (speed, reliability, traffic flow) and site accessibility performance of the arterial redesign. Designing individual projects and investments to achieve those transportation and accessibility objectives will also support continued business vitality.

The most common business concerns relate to restricted turn movements, delivery accessibility, reduced business visibility from the arterial, and potential restrictions to circulation or business frontage associated with corridor rights-of-way expansion. All of these factors can be addressed in some manner during the design process. For example, the impacts from turn restrictions can be minimized through careful design of U-turn opportunities both at intersections and mid-block where right-of-way is sufficient. Florida DOT Median Handbook evaluated the midblock U-turn, which can serve as a reference[61]. And right-of-way needs can be kept to a minimum through a comprehensive corridor design. Combining roundabouts with medians may reduce the cross-section of street segments; thus preserving more property for fronting businesses, parking spaces, and site circulation.

## EFFECT OF SHORT-TERM CONSTRUCTION DISRUPTION ON BUSINESS PERFORMANCE

The general literature on how infrastructure construction affects nearby business performance is fairly extensive and is beyond the scope of this review. Typically, larger infrastructure projects will develop a detailed construction staging and business impact mitigation strategy. Features of such strategies may include:

- Staging and phasing strategies that maintain access to businesses during primary business hours.

[59] Der Isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie, oder Untersuchungen über den Einfluss, den die Getreidepreise, der Reichtum des Bodens und die Abgaben auf den Ackerbau ausüben, Vol. 1
[60] Weber, Alfred “Theory of the Location of Industries”, Translated in 1929.
[61] “2014 Median Handbook, Florida Department of Transportation,” 2014

- Rerouting of traffic and pedestrian access to maintain best access to the most affected businesses.
- Communication and advertising campaigns to prepare businesses for disruption and alert customers of businesses still in operation.
- Signage and wayfinding to assist customers as they access business locations.

It is still often the case that disruptions during construction will have some detrimental influence over customer visitation and sales on businesses that are most impacted by the construction activities and road restrictions or closures. In the literature on street redesigns that address safety and congestion deficiencies, only the study by Eisele and Frawley[62] examined the construction impacts as well as the post completion impacts on businesses. Based on their survey of affected businesses even as the median installations were seen to lead to increases in customer visits and gross sales after completion, the construction impacts were considered to be universally negative.

The reviewed literature suggests construction impacts will be experienced most profoundly by businesses dependent on passer-by traffic (e.g. retail as opposed to services).

## LONG-TERM ECONOMIC DEVELOPMENT BENEFITS

Long-term gains to the economy reflect some underlying change in the productivity of resources available to advance economic activities. Investments in transportation can make other resources (labor and other inputs) more productive and can lower the costs of acquiring goods and services. The reconfiguration of arterial streets to address underlying safety and congestion deficiencies are no different from any other investment in transportation infrastructure. If the value of the safety and mobility benefits of the investments is greater than the costs of implementation, then there will be gains to the economy. Those gains may be capitalized in the form of income, business product, and property values.

Unless street redesigns alter productivity functions[63] in some material way, these kinds of changes will be primarily distributional. Areas that have been redeveloped (such that speeds, reliability, and safety are improved) may see more consumer activity and spending, but the total spending in the region is unlikely to change in any measurable way.

[62] Eisele, William and William Frawley. 2000. "A Methodology for Determining Economic Impacts of Raised Medians: Final Project Results." Texas Transportation Institute, Texas A & M University System.
[63] An example could be increases in extra-regional tradable production.

We found nothing in the literature we reviewed regarding how businesses outside of a redesigned arterial area are affected by the implementation of the transportation infrastructure investment (the distributional issue). Our conclusion, based on a substantial literature in urban economics, is that unless regional economic conditions are changed in a sudden and notable way, then local policies that affect business operations lead to effects that are primarily distributional. Locations that receive new investment will probably do better economically than those that do not. Unless new development is of a scale and type that draws investment from outside the region, then the economic gains will be economic activities that would otherwise have gone elsewhere in a region.

In terms of consumers and consumption patterns, for arterial redesigns to change aggregate consumption they would need change the number of consumers, their incomes, preferences, rates of spending/saving, or the cost of goods. On the one hand, the cost of consuming goods may decrease because the transportation costs to the consumer of purchasing the good may decrease. On the other hand, higher densities and land values may work in the direction of higher rents and higher prices.

Based on the literature it is unlikely that arterial redesigns decrease consumption overall, or to any substantial degree. Some types of arterial redesigns lead to modest changes in mode of access. Some literature reviews the consumption patterns of customers that use different modes (auto versus bike or walk) of accessing businesses. “When demographics and socioeconomics are controlled for, mode choice does not have a statistically significant impact on consumer spending at convenience stores, drinking establishments, and restaurants.”[64] In fact (excluding supermarkets) pedestrians and cyclists may consume more. “When trip frequency is accounted for,[65] the average monthly expenditures by customer modes of travel reveal that bicyclists, transit users, and pedestrians are competitive consumers and for all businesses except supermarkets, spend more, on average than those who drive.”[66]

The land development impacts of arterial redesigns are also very difficult to evaluate or predict. Even if a redesigned street produces notable gains from addressing congestion and safety issues, leading to increased consumer spending and gross business receipts, and finally higher land values – the development outcomes are still not necessarily obvious. Higher land values result in a higher residual value of land in the property development process. This can represent a barrier to redevelopment. Often investments in infrastructure alone are not sufficient to induce new property development and other factors such as zoning, development

[64] Clifton, K. J., Muhs, C., Morrissey, S., Morrissey, T., Currans, K., and Ritter, C. 2012. *Consumer Behavior and Travel Mode Choices*. Oregon Transportation Research and Education Consortium.
[65] Previous studies that did not control for trip frequency found that automotive-based consumers spent more per trip. Though automotive consumers spend more per trip, non-automotive consumers have greater frequencies of trip. Clifton et al., 2012.
[66] Clifton, K. J., Muhs, C., Morrissey, S., Morrissey, T., Currans, K., and Ritter, C. 2012. *Consumer Behavior and Travel Mode Choices*. Oregon Transportation Research and Education Consortium.

regulations and parking regulations must be altered before the dynamics of the development process are altered sufficiently to result in changes in the built environment.

## CONCLUSION

The literature reviewed consisted of studies that attempt to measure the effect of arterial street reconfigurations on retail sales and business performance. Well-designed studies that control for a wide range of factors influencing business performance are difficult and expensive to implement and, as a result, are scarce. A review of the available literature concluded that there is no evidence that the implementation of access management strategies, and raised medians and roundabouts in particular, result in broad negative impacts to businesses. To the contrary, a number of studies identified positive business outcomes. Improved business performance results from addressing underlying traffic congestion and safety deficiencies. General urban economic theory dictates that should investments change business site accessibility and gross sales, those changes should eventually be captured in the value of the underlying property rather than the profitability of a specific business. While changes in land values may be observed, those changes may not indicate business gains or losses in terms of sales or profits.

There is some evidence that auto-oriented businesses (e.g. gas stations, auto servicing) and businesses in mid-block locations may be more susceptible to lower customer visitation as a consequence of access restrictions (restricted turn movements, limitations in sight lines, etc.). Also, businesses that rely upon opportunistic visitation (where the business is not a primary customer trip destination) may be affected by access restrictions should their business become less visible to pass-by traffic. And some literature suggests that business losses during construction may be the primary negative effect on business performance. Such construction impacts would occur from any corridor construction, independent of the final configuration of the project.

# APPENDIX A: LITERATURE REVIEWED

This appendix contains the literature cited in the memo above as well as literature reviewed and considered throughout our research process.

## Appendix A: Literature Reviewed

| Title | Author(s) | Year | Summary |
|---|---|---|---|
| Nickerson Street Rechannelization Before and After Report | (see DKS report) | 2004 | DKS Case Study. Speeding and collisions down significantly after the road diet. Change in total average weekday volume was negligible, about a 1% reduction. No business impacts are discussed. |
| The Relationship of Transportation Access and Connectivity to Local Economic Outcomes: A statistical Analysis | Alstadt et al | 2011 | This article asks the right question: how does transportation infrastructure affect delivery of product inputs, labor market access, and customer access? But the analysis is on a county-level rather than street or neighborhood level, so it isn't useful when looking Main Street. |
| Complete Streets | American Planning Association | 2010 | 200-page review with excerpts from several sources |
| The Effects of Traffic Flow on Residential Property Values | Bagby, DG | 1980 | This article presents an empirical study of the effects of traffic flow on residential property values in the community of Grand Rapids, Michigan. Residential values in two identical neighborhoods are compared over a 25-year period. One neighborhood serves as a control for the measurement of the impact of changes in traffic flow upon residential values in the other. The results show that residential property values exhibit a surprisingly high elasticity with respect to reductions in traffic flow. |
| Trends in Local Business Sales, Building Values, and Office Rents at NYCDOT Street Improvement Project Sites | Bennett Midland | N.d. | Evaluated the effects on business sales following various types of street improvements including medians, bike lanes, traffic pattern alterations, and creation of new public spaces. At 8 of 11 sites (73%) business sales increased at a greater rate than at comparison areas. At 9 of 11 sales increased in the first year after improvements. The projects may have promoted economic growth. Commercial building values increased at 4 of the 6 sites with available data. |
| From Policy to Pavement: Implementing Complete Streets in the San Diego Region | Bleir, A., Ferrier, K., Hamilton, A., Konar, G., Peterson, B., Sorenson, D., and Torma, S. | 2012 | Mostly advocating for Complete Streets in San Diego, but this article does lay out the range of benefits that stem from Complete Streets including branding and revitalization of commercial districts |
| Final Report for Secretary Department of Transportation and | Burk-Kleinpeter, Inc. | 2010 | Summarizes the costs and benefits of complete streets. Economic benefits: houses with higher walkability command higher prices; 66% of San Fran Mission District businesses believed that bike lane had positive |

Appendix A: Literature Reviewed

| Title | Author(s) | Year | Summary |
|---|---|---|---|
| Development | | | impact on business or sales; bike friendliness |
| Edgewater Drive Before & After Re-Striping Results | City of Orlando - TPB | 2002 | DKS Case Study. 34% reduction in crashes. 68% reduction in injuries. Significant reductions in speeding. 9-12% reduction in daily traffic volume (depending on segment). Pedestrian traffic increased by 23%, bicycle by 20%. Side street traffic reduced by 4%, on average. Travel times increased from about 3.3 minutes to 4.2 in the AM, and a mix of increases and decreases depending on direction in the PM. |
| Fourth Plain Boulevard Demonstration Re-Striping Project - Post Implementation Report | City of Vancouver - Transportation Services | 2004 | DKS Case Study. A study was commissioned to estimate "taxable retail sales" in the area. The study found that the area faired no worse than its peers and in 2002-2003, the last year of the study, the area faced a 4.7% decline in revenues versus 9.8% and 25.0% declines in other nearby commercial zones. 2 consumer complaints were made that regarded traffic signal timing. |
| The Path to Complete Streets in Underserved Communities | Clifton et al | N.d. | Conducted four case studies about getting complete streets in underserved communities. |
| Consumer Behavior and Travel Mode Choices (see also, Clifton et al Business Cycles….) | Clifton, K. J., Muhs, C., Morrissey, S., Morrissey, T., Currans, K., and Ritter, C. | 2012 | Research based in the Portland metro area. Supermarkets had the highest share of private vehicle use, 86%. Drinking places have the lowest, 43%. High-turnover restaurants, 64%. Convenience Stores, 59%. Automobile consumers were found to spend more per trip, but not statistically different amounts on a monthly basis (fewer trips). Bikers spend more each month than automobile drivers at restaurants, drinking establishments, and convenience stores (table 4-2). Several other useful results relate to directness and connectivity as significant predictors of someone choosing bicycle mode of transportation. |
| Complete Streets Spark Economic Revitalization | Complete Streets Steering Committee Organization | N.d. | 2-page summary pamphlet of the economic revitalization that many areas have experienced after implementing complete streets programs |
| Portland's Green Dividend | Cortright - CEOs for Cities | 2007 | Makes the argument that Portlanders save money by not using cars as much, which leaves them with more money to spend in the local economy. Car and Gas money also leaves Oregon immediately. |
| Walking the Walk: How Walkability Raises Home Values in U.S. Cities | Cortright, J. | 2009 | In this report, Cortright linearly regresses property values against a measure of walkability and finds that properties with higher walkability scores are associated with higher property values. As explained in our white paper, though this is an encouraging finding, we are reluctant to rely on it to understand the potential effects of complete streets. We bring it up, in part, because in our survey of the literature, Cortright's article was widely |

Appendix A: Literature Reviewed

| Title | Author(s) | Year | Summary |
|---|---|---|---|
| | | | cited. |
| Economic Effects of Access Management Techniques | Cunningham, C., Schroeder, B., Findley, D., Foyle, R., Katz, D., Smith, S., Carter, D., and Miller, M. | 2010 | This study employs a perception-based survey technique with the use of comparison sites to create a pseudo before-after study. Owners of businesses along treatment corridors viewed access management techniques in a more positive light than the perceptions of those on comparison sites. Their similar performance in terms of business revenues indicates that there is no direct evidence of negative economic impacts due to access management installations. |
| Road Diet Seminar | Daisa | N.d. | Provides an overview of road diet practices, where the policies are best implemented, and the typical effects on traffic patterns and accidents. Not much on businesses |
| Economic Effects of Traffic Calming on Urban Small Businesses | Drennen, Emily | 2003 | Drennen interviewed 27 merchants in the Mission District about Valencia Street bike lanes. 44.4% said economic revitalization was "Better", 0% said it was "Worse." 46.2% said reduced auto speeds had a "Better" effect on sales, 7.7% said it was "Worse." 37% said sales were "Better," 0% "Worse" .... and several other useful results (page 46). 65.4% said it had a better general impact on business and sales, 3.8% said worse. Categorizes the benefits that small businesses get from "traffic calming" efforts and provides examples from the literature for each: Economic Revitalization and Property Values; Attractiveness and Safety; Sales and Attracting Customers; Parking; Impact on Employees; Construction and Costs. Customers who drive less have more disposable income. |
| Economic Impact of the Public Realm | ECOTEC | 2007 | Includes several case studies of public realm projects and their economic impacts in Europe. |
| A Methodology for Determining the Economic Impacts of Raised Medians: Final Project Results | Eisele, William and Frawley, William | 2000 | Survey-based research. Found that business perceptions of business impacts prior to the project were worse than actuals. There were negative impacts during the construction phase |
| Re: Post Road Diet Assessment - January through October | Faught, Mike | 2013 | A post implementation assessment of the engineering outcomes of a road diet investment as well as a survey of household attitudes about the road reconfiguration; showing slightly positive attitudes overall. |

## Appendix A: Literature Reviewed

| Title | Author(s) | Year | Summary |
|---|---|---|---|
| Evaluation of Lane Reduction "Road Diet" Measures and Their Effects on Crashes and Injuries | FHWA | 2004 | Looked at 24 comparison sites in California and Washington. "On average, crash frequencies at road diets in the after period were approximately 6 percent lower than at the corresponding comparison sites." Road diets, however, did not have an effect on crash type or crash severity, but this study did not account for speed at the time of crash. |
| A Comparative Analysis of Bicycle Lanes Versus Wide Curb Lanes: Final Report | FHWA | 1999 | Summarizes the trade-offs between wide sidewalks and bike lanes. |
| Bike Lanes, On-Street Parking and Business | Forkes, J. and Lea, NS | 2009, 2010 | Survey research of drivers, pedestrians, and cyclists to a commercial neighborhood in Toronto. Mostly focuses on the transition from parking spaces to bike lanes and/or sidewalk space. Finds that most businesses and customers consider the shift towards more walkability and bikability to be advantageous. |
| Post Road Diet Assessment - January through October | Fraught, Mike | 2013 | North Main St in Ashland, OR. Mostly a traffic and crash analysis, but also surveyed 552 residents and interviewed 38 of 50 businesses. 3/4 of business said that the reconfiguration had no impact on business. For most of the other 1/4, deliveries to their location were negatively affected. Businesses were evenly split on whether they wanted to keep the new configuration or go back to the 4 lane configuration |
| Pedestrian and Bicycle Infrastructure: A National Study of Employment Impacts | Garrett-Peltier, Heidi | 2011 | In this article, Garrett-Peltier uses IMPLAN to evaluate the direct, indirect, and induced employment that is created through the design, construction, and materials procurement of bicycle, pedestrian, and road infrastructure. She found that these projects created more design and construction jobs than automotive projects, and attributed this to pedestrian and bicycling projects' higher labor intensity. |
| Roundabout's Impact on Nearby Businesses | Godavarthy, R. P., Mirzazadeh, B., Russell, E. R., and Landman, D. | 2016 | A folio summarizing the results of the 2012 study. See Russell. |
| The Economic Costs of Road Traffic Congestion | Goodwin, Phil | 2004 | An economic text outlining the economic consequences of road congestion, including the role of travel time unreliability. |
| Stability in Competition | Hotelling, Harold | 1929 | Theoretical text on the role of product differentiation on the optimal location of firms. |

## Appendix A: Literature Reviewed

| Title | Author(s) | Year | Summary |
|---|---|---|---|
| How Much Do You Lose When Your Road Goes on a Diet? | Huang et. al. | 2003 | Focuses on crashes. Finds no significant impact on crash rates |
| Maximizing the Economic Returns of Road Infrastructure Investment. Chapter 3:The Relationship Between Road Infrastructure Investment and Economic Development | Joynt, Hubert | 2009 | Theoretical, as described in the title. |
| Economic Impact of Traffic Incidents on Businesses | Khattak et. al. | 2008 | Focused on North Carolina's interstate highways. Found a significant cost per hour of delay for accidents, but this cost varied by type of business. Did not focus on demand-side delays, just supply-side. Retail cost was $156/hr of delay. |
| RE: Fire/EMS Input on "Road Diet" Projects | Kingsbury, Dwight | 2013 | Kingsbury is the FDOT Safety Officer in Tallahassee, FL. This memo argues that a 3-lane reconfiguration may improve EMS response over 4-lane configurations. |
| Urban Minor Arterial Four-Lane Undivided to Three-Lane Conversion Feasibility: An Update | Knapp et. al. | 2003 | Researches the traffic effects of 4-3 lane conversion. Based on simulations, recommends that areas with peaks under 750 vphpd will see few impacts. Those from 750-875 require caution in implementing a conversion. The authors express a lot of concern for those about 875 vphpd. Most simulations had a significant reduction in speeders. |
| The Economic Impact of Investments in Bicycle Facilities: A Case Study of the Northern Outer Banks | Lawrie et al - NCDOT | 2004 | Survey research to measure the impact of significant investment in bicycling infrastructure. Investment in bicycling infrastructure has paid dividends. Mostly focuses on tourists and found that bicycle access was much of the reason some tourists visited an area |
| Bike and pedestrian street improvements and economic activity in NYC | Lee, BS and Sprung, B. | 2013 | In this study of New York City street improvements, Lee and Sprung find that the improvements—which included bicycle infrastructure, street trees, sidewalk improvements—in some cases led to higher sales tax revenues, which indicates greater consumption. In other cases, the revenue was lower or was not significantly different than it was previously. |

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| Title | Author(s) | Year | Summary |
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| Walk this Way: The Economic Promise of Walkable Places in Metropolitan Washington, DC | Leinberger & Alfonzo | 2012 | Findings start on page 9 with summary table. Found that a 1-level increase in the walkability index (IMI) resulted in higher average office and retail rent per sq. ft., higher retail sales, higher res rents, and average home values. |
| Evaluating Transportation Economic Development Impacts | Litman, Todd | 2010 | Mostly theoretical guidance on how to measure the economic impacts of transportation projects. On page 52 is the "Impacts on Specific Industries and Businesses" section. This discussion includes how "old" industry tends to favor automobile traffic and "new" industry does not. Since new industry tends to be where expansion is possible, public policy should support programs that support newer types of industries. Page 78 has an example of shift from vehicle spending to general consumer spending that occurs if there's a shift from car travel to other types of travel. |
| Generated Traffic and Induced Travel | Litman, Todd | 2010 | See other Litman articles. This mostly is about how to value consumer surplus of transportation shifts and does not touch on the effect on businesses. |
| Evaluating Complete Streets | Litman, Todd | 2013 | Mostly advocacy, but Table 7 provides a guide to quantification of often overlooked impacts, which the city might be interested in seeing at some point. |
| Traffic Calming Benefits, Costs and Equity Impacts | Litman, Todd | 1999 | Provides a framework for doing a cost benefit analysis or road diet projects. Monetizes many costs and benefits (e.g. crashes) that aren't monetized elsewhere. Provides an example of Bridgeport Way where tax revenues increased in the years after a road diet relative to tax revenues from the whole city. Unfortunately, doesn't cover this topic anywhere else in the paper. |
| Safety and Operational Analysis of 4-lane to 3-lane Conversions (Road Diets) in Michigan | Lyles et. al. | 2012 | Finds that diets for areas with ADTs over 10K face significant delays, but this mostly applies to sites with peak hour volumes above 1000. 4L4W doesn't point this out. Nor do they point out that the study said all the effects are almost entirely corridor-specific. 4L4W also neglects to point out that the study found that road diets resulted in lower crash frequencies, but again have a lot of site-to-site variation. One appendix has a detailed literature review. |
| Access Management Research and Awareness Program Phase IV Final Report | Maze, T. and Plazak, D. | 1999 | Case studies. As seen with previous case studies in this series, these two projects had positive impacts on traffic safety and operations and do not appear to have adversely impacted the vitality of businesses along the managed corridor. |

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| It's a Safe Decision: Complete Streets in California | McCann, B., Meyer, A., Wood, J., and Morfas, C. | 2012 | This report compiles complete street case studies in California to argue that their implementation should be more widespread. The case studies collectively provide a fairly comprehensive picture of the effects of complete streets. However, in discussing economic activity, other factors are not controlled for. |
| York Blvd: The Economics of a Road Diet | McCormick, Cullen | 2012 | York Blvd, Los Angeles. Relies on qualitative and quantitative data. Most businesses presumed that their customers arrived by car, but these notions were mistaken. Business turnover road diet v non-road diet 55% v 62%; did not find statistically different property values; non-road diet areas had a higher growth rate in revenues, but road diet portions had a higher absolute increase in revenues. In sum, "The quantitative analyses in this report do not reveal meaningful linkages between the presence of a road diet and changes in economic conditions." |
| Willamette Street Traffic Analysis | McKenney Engineering | 2001 | Previous evaluation of improvement alternatives for same stretch of Willamette |
| The Many Benefits of Complete Streets | National Complete Streets Coalition | 2013 | A communication piece outlining the benefits of complete streets without a discussion of the costs or tradeoffs. |
| Complete Streets Spark Economic Revitalization | National Complete Streets Coalition | N.d. | This brief on complete streets argues that complete streets lead to transformative economic changes. Though much of it is informative, it operates as advocacy, and not rigorous analysis. We cite it as such. |
| Economic Development | National Complete Streets Coalition | N.d. | In this article, the National Complete Streets Coalition argues that complete streets lead to transformative economic development, raising property values and investment. We cite it as advocacy, and not as rigorous analysis. |
| Washington's Complete Streets and Main Street Highways Program: Case Studies and Practice Resource | Nicholls et. al. | 2011 | Mostly advocacy and general description of what the WA Complete Streets program does. |
| Measuring the Street: New Metrics for 21st Century | NYDOT | 2013 | Meant to be a pamphlet. For the first protected bike lane in the US, 8th and 9th avenues in Manhattan, says that locally-based business on 9th from 23rd-31st had "up to 49% increase in retail sales" compared to a 3% |

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| Streets | | | increase borough wide. There was also "49% fewer commercial vacancies" compared to 5% borough-wide. Dedicated lanes for buses and bike on 1st and 2nd Avenues in Manhattan: 47% fewer commercial vacancies compared to 2% borough-wide. |
| The Economic Benefits of Sustainable Streets | NYDOT | 2013 | Follows up on the 2012 Measuring the Street study to update metrics to accurately measure the impacts of street revitalization. Has a good lit review and makes the case that street improvements and traffic calming increase the number of shoppers, revenue, and property values. Also points out that businesses are typically opposed to projects beforehand. Provides a summary of the biases present in the 2011 Stantec report. NYDOT, with consultants, developed their own metric which includes retail sales tax filings, commercial leases and rents, and city-assessed market value. Methods included paired comparisons between sites and boroughs, and other comparisons between sites other similar sites within the neighborhood. Evaluated the addition of street corridors and plaza on retail trade and food businesses over two years before and after a project. Offers several lessons for doing this type of research in the future. Includes 3 Manhattan, 2 Bronx, and 2 Brooklyn Case studies |
| New York City, New York Municipal Forest Resource Analysis | Peper et. al. | 2007 | Mostly irrelevant - cited in NYDOT 2013 paper - but p. 59 has a discussion of the effect that additional trees have on property values and other factors. People are willing to pay 3-7% more for properties with ample trees versus no trees. |
| Road Diet Handbook - Overview | Rosales, Jennifer | N.d. | Provides a number of case studies of road diets. Does not include much information on effects on businesses, but does cite a Vancouver case where sales increased when compared to similar, non-road diet sites in the area. |
| Bikenomics: Measuring the Economic Impact of Bicycle Facilities on Neighborhood Business Districts | Rowe, Kyle | 2013 | Concludes that the addition of bicycle lanes did not have a negative impact on business districts. |
| Street Redesign for Revitalization: West Palm Beach, FLA | Rush, N., Actman, L., McMahon, P., and Renski, H. | N.d. | This case study of West Palm Beach Florida attributes the area's transformative economic change to complete streets, but fails to control for other factors (i.e., it does a before/after analysis, where a with/without would be more telling). |
| A Study of the Impact of Roundabouts on Traffic | Russell, E. R., Landman, D., | 2012 | This study reviewed the literature and all sources where national data or reliable case studies addressed the issue of the impact of roundabouts on business to serve as a basis for Kansas studies. The most relevant |

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| Flows and Business | Godavarthy, R. P. | | study found in the literature was a study of South Goldman Road in Golden, Colorado, where four roundabouts were built in a business corridor with many positive results which led to the conclusions that “yes, roundabouts are good for business.” Survey results were generally positive albeit mixed. The simulation study of the Topeka business area, assuming several intersections were replaced with roundabouts, showed significant reductions in delay and queuing for most all significant traffic movements. Based on the authors’ assumption that better traffic flow and access are good for business, it was concluded that the addition of roundabouts in this corridor would have been good for business. The overall conclusion of the study was that roundabouts have a positive impact on traffic flows and business. |
| Transportation and The Economy | SACTRA | N.d. | 298-page document that provides a lot of theoretical guidance. Euro-centric, but still useful. Chapter 7 is all about how traffic reductions may affect economies, some highlights. Unfortunately, it focuses on taxation and other policies as means to reduce congestion "The external costs arising from road transport provide a rationale for traffic reduction, insofar as this arises from the alignment of marginal benefit with marginal social cost." (p 129) |
| Polk Street Intercept Survey Results | San Francisco Municipal Transportation Agency | 2013 | Focuses on consumer spending by mode of transportation to the region. Cars spent more per TRIP than cyclists, pedestrians, and transit, but had lower per WEEK spending than all three types. |
| Curbing Cars: Shopping, Parking and Pedestrian Space in SoHo | Schaller Consulting | 2006 | Conducted 1000 interview, pedestrians and motorists. Concluded that most visitors, residents, and workers wanted less parking space and more pedestrian space. Also asked respondents about spending patterns. |
| 38th Avenue Corridor Plan Implementation | Showalter, Sarah | 2012 | 38th avenue in Wheat Ridge, CO. At the very end does a simple before and after measure of sales tax revenue |
| The Economic Value of Active Transportation | Snyder, R. | N.d. | In this fact sheet, Snyder reviews the literature and finds that homeowners are willing to pay more for walkable, bikable, low-traffic, quiet streets. The author supports his conclusions largely with case studies. Since this is a fact sheet, it does not lend itself to great scrutiny. |
| Vancouver Separated Bike Lane Business Impact Study | Stantec Consulting | 2011 | Collected business economic data to measure impacts of 2 bike lanes. The net impact on sales at business adjacent to the bike lanes was -10% and -4%, respectively. Business owners estimated losses to be between -6% to -9%. These loses were found to be insufficient to create persistent vacancies. Customers reported comparable reductions in visiting the two areas; the reasons for these reductions were traffic congestion, less parking, turning restrictions, and reduced pedestrian safety. Provides a list of recommended mitigation |

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| | | | measures, but many of these are specific to a dense downtown area. |
| Methodology for Determining the Economic Development Impacts of Transit Project | TCRP - TRB | 2012 | Focuses on travel time savings, costs of construction, environmental impacts, effects on land development, and effects on agglomeration economies. It is one of the first studies to look at the later, or so it claims. Does not focus on business impacts |
| Application of a Case Study Methodology | Tellis, W. | 1997 | A methods document on the design, role and limitations of the case study approach to research. |
| Der Isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie, oder Untersuchungen über den Einfluss, den die Getreidepreise, der Reichtum des Bodens und die Abgaben auf den Ackerbau ausüben, Vol. 1 | Thünen, Johann Heinrich von | Translated in 1966 | Classic text in economics on land rents and transportation. |
| Der Isolierte Staat..., Vol II: Der Naturgeässe Arbeitslohn und dessen Verhältnis zum Zinsfuss und zur Landrente, Part 1 | Thünen, Johann Heinrich von | Translated in 1966 | Classic text in economics on land rents and transportation |
| East Village Shoppers Study | Transportation Alternatives | | 420 surveys with pedestrians. Pedestrians and bikers spend more per capita per week at local businesses and visit the neighborhood more often than car and subway users. Recent additions of bike lanes increased bike use dramatically. 73% of respondents said the lanes had a positive or very positive impact on the neighborhood. |
| Linking Transportation and Land Use | Transportation Research Board | 2006 | State of the evidence on the relationships between lane use and transportation. This report is essentially a compilation of case studies of transportation and land use projects. Though none of the projects examined are explicitly complete streets, the projects share many things with complete streets (traffic calming, streetscape improvements, etc.). Many of the case studies describe increased retail and consumer activity after a project, |

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| | | | though these descriptions are too brief to lend themselves to greater scrutiny |
| New Tool for Estimating Economic Impacts of Transportation Projects: Transportation Project Impact Case Studies | TRB | 2012 | Like the study above, focuses on highway expansion. Not relevant to impacts of changes to city streets. |
| Economic Impacts of Access Management | Vu, Patrick | 2002 | A report prepared for the Washington State Transportation Commission examined the relationship between business perceptions of access management and business perceptions of their own performance. |
| Theory of the Location of Industries | Weber, Alfred | Translated in 1929 | Alfred Weber formulated a theory of industrial location in which an industry is located where the transportation costs of raw materials and final product is a minimum. |
| Progress and Challenges in the Application of Economic Analysis for Transport Policy and Decision Making | Weisbrod & Alstadt | 2007 | Discussion paper on the interaction between transportation and economic modeling. |
| Economic Effects of Restricting Left Turns | Weisbrod, Glen E. and Neuwirth, R. | 1998 | The objective of this research was to determine the economic effects on adjacent businesses and property owners because of restricting left-turn movements. The statistical analyses conducted with the available data indicate that left-turn restrictions affect different types of businesses differently. Gas stations, non-durable goods retailers, and service businesses appear to be the most likely to be adversely affected; where restricted, these businesses showed the largest sales declines, and the highest rates of business failures. Businesses at mid-block locations (i.e., away from intersections) perceived the left-turn restrictions as more detrimental than did businesses at intersections or other points where left turns were permitted. In some cases, left turn restrictions appeared to cause a portion of sales to shift from the restricted to the unrestricted business locations within the study corridor. |
| Measuring the Economic Costs of Urban Traffic Congestion to Business | Weisbrod, Glen et. al. | 2003 | Uses data from Chicago and Philadelphia, and is explicit that their findings are specific to "large urban areas." Each sector if affected in different ways by congestion, as each relies on freight, customer, etc. road use to different degrees. Impacts also depend on location (e.g. industrial v. downtown). Losses are not put in a /minute drive time or /daily visits measure. |

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| Raised Median Economic Impact Study | Utah DOT; Matt Riffkin, C. Allen, M.Baker, C.Richman, J. Dorwart | 2013 | In this study businesses sales tax records in three corridors (plus control corridors) where raised medians were implemented were examined to evaluate the economic impacts of the corridor operational changes. The affected businesses performed as well as, or better than, the control group corridors. Business perceptions were also assessed through surveys. In spite of no evidence for poorer business performance business perceptions of raised medians was that they impeded customer access. |
| Operational and Economic Analysis of Access Management | South Carolina DOT | 2018 | This study examined both operational and economic impacts of access management in six corridors in South Carolina. The perception of customers and businesses located along corridors with raised medians were surveyed. Economic impacts were examined using data about sales volumes over a three year period. Analyses indicated that the sales volume decrease of the affected businesses was similar to that of businesses in the control group. This finding suggests that the installed raised median was not the reason the affected businesses experienced a reduction in sales volume. |
| | | | |
| Business District Streetscapes, Trees, and Consumer Response | Wolf, KL | 2005 | In this study, Wolf surveyed consumers to examine how they respond to forested urban streetscapes. She found that on forested streetscapes, consumers viewed stores and products more positively, travelled and stayed longer at stores, and were willing to pay more for parking and products. |
| PPS Right Sizing Case Studies | | | There are several case studies here. None address economics. They all address volumes, crashes, etc. |