

# **Express Bus Transit Study: A Case Study**

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# 1. Introduction

Clay County Rural Transit (CCRT) is considering the implementation of an express bus system to serve commuters between the Wahpeton-Breckenridge and Fargo-Moorhead metro areas, a 55-mile trip. CCRT runs a similar service between Detroit Lakes, Barnesville, and Fargo-Moorhead. The bus would stop at designated areas using a park and ride system. A questionnaire was created to determine travel needs of potential users and gauge potential interest in such a service.

The objectives of the study were to:

1. Determine the number of regular commuters between the Wahpeton-Breckenridge and Fargo-Moorhead metro areas,
2. Make commuters aware of the cost of driving their personal automobile and compare that cost to that of using commuter bus service,
3. Discover the willingness of commuters to utilize commuter bus service,
4. Determine what commuter bus service features were of utmost importance to travelers, and
5. Gauge the awareness of local commuters to commuter bus service and its features.

The report begins with a description of common commuter service features, followed by a discussion of the proposed commuter bus service. Survey design methodology is then discussed highlighting companies whose employees completed the survey. This was followed by survey results and findings. The study concluded with recommendations for commuter service between Fargo-Moorhead and Wahpeton-Breckenridge. For those interested, an in-depth literature review of express bus aspects referred to as bus rapid transit (BRT) and political frameworks for BRT are included in Appendix A.



## 2. Commuter Service Features

The research team was unable to find information pertaining to commuter service in small urban and rural communities. Little service exists on this level and research based on existing small urban and rural commuter service is even harder to find. However, Bus Rapid Transit (BRT) encompasses many similar features when compared to commuter service. Its objectives are similar, although more complex than commuter service when comparing features. Commuter service, as proposed in this research, can be considered a simpler form of BRT, which is found in urban locations in the United States and throughout the world. For detailed information on BRT, see Appendix A.

### 2.1 Common Elements

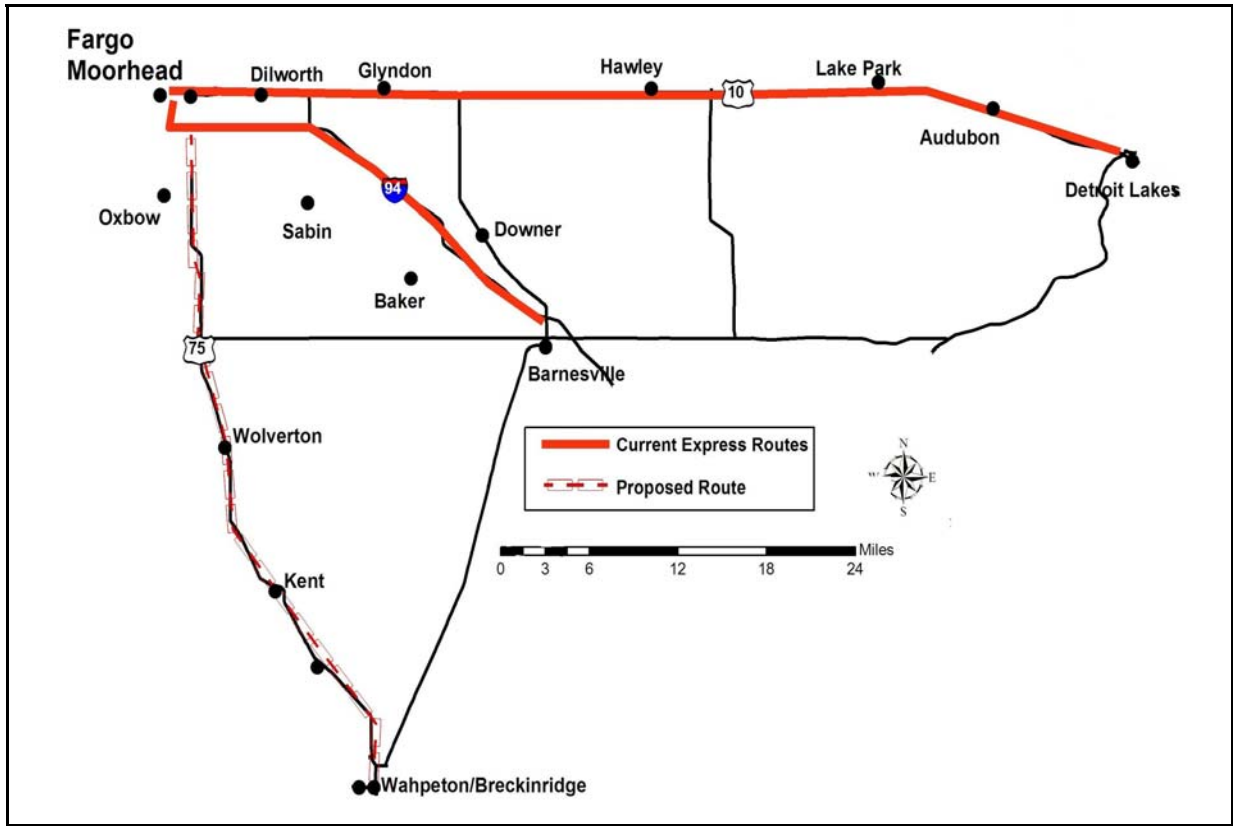
The five major elements the BRT systems encompass are 1) vehicles, 2) guideways, 3) control systems, 4) fare collection systems, and 5) passenger information systems. The systems may not have each of these elements, but they are likely to have all or some combination of them. Commuter service in rural areas is much less complex, but uses the same idea of getting riders to their point of destination in a scheduled amount of time. Quality vehicles are important to maintain the efficiency of the entire operation and passenger information via the Internet can provide riders with stop times and route information allowing them to plan their optimal route. Elements such as guideways, control systems and high-tech fare collection systems are of little use in rural areas due to low volume traffic and ridership.

### 2.2 Western Minnesota Commuter Bus Service

The Clay County Rural Transit (CCRT) Authority in Moorhead, Minnesota, operates two commuter service routes serving western Minnesota. Figure 2.1 shows both routes and the communities they serve. It is also expected that CCRT would operate the proposed Wahpeton-Breckenridge commuter route if this service is approved.

The Detroit Lakes to Fargo-Moorhead route serves six communities with morning service from 6:20 a.m. to 7:20 a.m. and a return trip from 4:45 p.m. to 6:00 p.m. The six communities served by this route include Dilworth, Glyndon, Hawley, Lake Park, Audubon, and Detroit Lakes. The Barnesville to Fargo-Moorhead route serves four communities starting from 6:15 a.m. to 7:00 a.m. with return service from 4:30 p.m. to 5:45 p.m. The four communities served by this route include Sabin, Baker, Downer, and Barnesville.

Wahpeton-Breckenridge express bus service runs on a similar schedule with possible stops being made in the vicinity of the Oxbow, Wolverton, and Kent. The total mileage of the route is nearly identical to that of the current Detroit Lakes route. Thus, the potential timing of the new route originates at approximately 6:30 a.m. in Wahpeton-Breckenridge and terminates in Fargo-Moorhead at 7:30 a.m. and return service departs Fargo-Moorhead at approximately 4:45 p.m. and arrives in Wahpeton-Breckenridge at 6:00 p.m.



**Figure 2.1** Current and Proposed Express Routes

Ridership data for both the Detroit Lakes route and the Barnesville route are highlighted below in Table 2.1. Data includes ridership and mileage for the first seven months of 2005. Ridership has a natural tendency to increase during winter months and decrease as the weather warms throughout the spring and summer. The Detroit Lakes commuter route serves greater populated communities compared to the Barnesville route. This is the main reason for the difference in total ridership between the routes.

**Table 2.1** Commuter Service Ridership and Mileage

|                 | 2005 Passengers |             | 2005 Mileage  |             |
|-----------------|-----------------|-------------|---------------|-------------|
|                 | Detroit Lakes   | Barnesville | Detroit Lakes | Barnesville |
| <b>January</b>  | 726             | 236         | 4565          | 2400        |
| <b>February</b> | 515             | 247         | 4344          | 2762        |
| <b>March</b>    | 555             | 274         | 4934          | 3223        |
| <b>April</b>    | 459             | 214         | 4476          | 2652        |
| <b>May</b>      | 430             | 171         | 4561          | 2968        |
| <b>June</b>     | 467             | 113         | 4499          | 2606        |
| <b>July</b>     | 75              | 95          | 4201          | 2425        |



## **2.3 Summary**

BRT history and the research pertaining to it play an important role in shaping the development and structure of future commuter services everywhere. Developing commuter service connecting Wahpeton-Breckenridge to Fargo-Moorhead must take into consideration both the advantages and disadvantages that the service will include. Awareness must also be taken of current express bus routes in the areas that will provide useful insight as to the makeup of the Wahpeton-Breckenridge route. Particular attention must be paid to the Detroit Lakes route as it has similar length and stop times compared to the proposed service. The following chapter develops the methodology of the research and contains both the survey instrument design and its distribution.



### 3. New Service Details

The new express bus service will begin by running on a three-month trial basis. The service would consist of approximately four operating hours per day from CCRT. The rate per hour is \$30, i.e., a total cost of \$120 for a four-hour day. This equates to a cost of \$7,920 for the three-month trial.

The trial service took place in the months of October, November and December 2005. Until the number of riders is established, additional funding will be needed to support the service at its onset. This funding amount will decrease with a sufficient number of riders, however the need for a local contribution will continue. Service for residents of Wahpeton-Breckenridge to Fargo-Moorhead would be paid for from a proposed funding plan as follows:

- Passenger Monthly Passes \$110
- Passenger Daily Passes \$10 Roundtrip
- Contributions from the cities of Wahpeton, Breckenridge, and Wilkin, and Richland Counties, at \$750 each. Totaling \$3,000 dollars for the three-month trial.
- The Fargo-Moorhead Council of Governments (the metropolitan planning organization for the Fargo-Moorhead area) would match the \$3,000 local contribution with Job Access Reverse Commute funding (JARC).

During the initial three-month trial, the target number of riders was 12-15 per day, which was not achieved. If this number would have been achieved, it would be feasible to continue the service with an additional 12 months of service funded as follows:

|                                  |  |
|----------------------------------|--|
| Annual Passenger Fares           | \$15,840 (for 12 passengers per month) |
| Subsidy from Local Jurisdictions | \$ 7,920                               |
| (JARC) Grant Match               | \$ 7,920                               |
| Total Cost for 12 Months         | \$31,680                               |

Implementing the proposed service would also involve a marketing plan which will be carried out by Clay County Rural Transit. Some of the possible marketing avenues include:

- Inserts in Utility Bills
- Local Chamber of Commerce
- Local Church Bulletins
- NDSCS
- City and County Websites
- Public Access Television

Upon project approval, more marketing strategies will be developed and implemented.

Georgia Beaudry, Clay County Rural Transit Manager, commented that everyone to be served by the commuter bus has been very receptive to the idea, and all communities have worked together successfully to implement the service. Ms. Beaudry also offered the following advantages that will stem directly from the new service (Beaudry, 2005). Advantages include:

- Affordable option for Wahpeton-Breckenridge area residents who are commuting to Fargo-Moorhead

- Transportation? Options for residents that would just like to go to Fargo-Moorhead for one day (medical, visiting, shopping)
- Commuters using the service will see it as a value to living in Wahpeton-Breckenridge.
- Potential to add Fargo-Moorhead residents to Wahpeton-Breckenridge. The empty backhaul trips that the commuter bus would take could possibly be used for Fargo-Moorhead residents that work in Wahpeton Breckenridge.
- The JARC grant that can match the local jurisdiction contributions provides a unique opportunity to try the service at a lower cost to the jurisdictions.
- This route would offer transportation to individuals in Wilkin County, an area that currently does not have any public transportation.
- Service complements rural transit in Richland County.

## 4. Survey Methodology

A three-page online survey was developed by members of the research team, the Fargo-Moorhead Metro Council of Governments (F-M Metro COG), and Clay County Rural Transit. The survey was designed to collect data regarding behaviors and attitudes related to commuter service from those passengers traveling between the Fargo-Moorhead and Wahpeton-Breckenridge metro areas on a regular basis.

### 4.1 Survey Instrument Design

The survey consisted of 16 questions asking respondents to indicate their various travel behaviors as well as demographic characteristics. Several questions pertaining to the cost of the service, service frequency, and reasons for using the service were included in the survey to determine why riders may use the service and what an acceptable fare would be. Questions involving proposed time periods for offering the service, wait times for bus transfers, and travel subsidy questions were also included. The final three questions of the survey dealt with the demographics of age, education level attained, and income level. Respondents remained anonymous as they were not required to provide contact information.

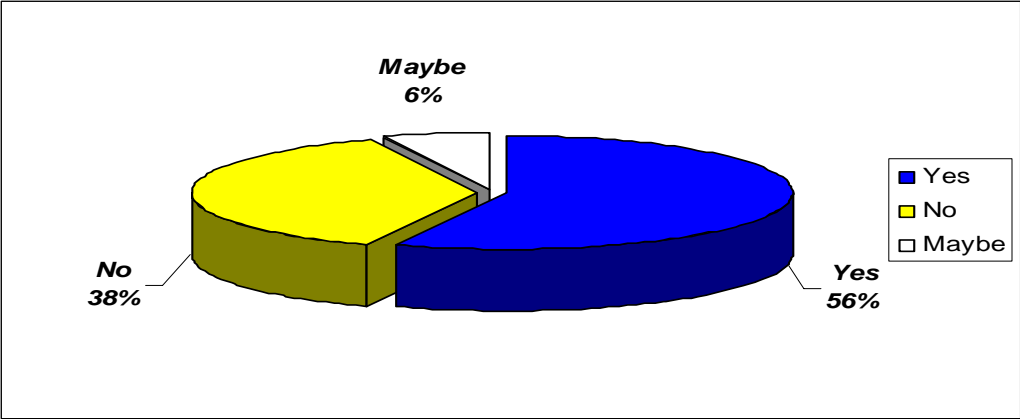
A table preceded the main body of the survey illustrating the cost of owning and operating a personal automobile and driving between the two metro areas on a daily basis (Table 5.1, Page 18). The table broke down all costs into cents per mile traveled. The average cost of operating a personal automobile was found to be roughly 50 cents per mile. Based on a total round trip of xxx miles and the estimated cost per mile, the cost of driving a personal automobile can easily be compared to the cost of the proposed express bus service. The table also provided a means of comparison between driving and riding the express route between the two metro areas.

### 4.2 Survey Distribution

An e-mail was sent by the F-M Metro COG on August 8, 2004, to major employers in both metro areas asking potential commuters to respond to the survey. The survey was available online until October 31, 2004. Some major employers contacted to distribute the survey included:

- Blue Cross Blue Shield,
- Meritcare,
- Cass County,
- City of Fargo,
- Fargo's Downtown Community Partnership,
- North Dakota State University,
- Minnesota State University (Moorhead), and
- Concordia College.

A total of 96 individuals completed the survey. Of those, 36 (38%) indicated that they do not currently nor do they plan to commute between the Fargo-Moorhead and Wahpeton-Breckenridge areas. Of the remaining 60 respondents, 54 (58%) indicated that they currently or plan to commute, and six responded "maybe." The 36 respondents who indicated that they did not commute between the areas were asked to disregard the remainder of the survey. Figure 3.1 shows the breakdown of those who took part in the questionnaire, and the overall response to commuting plans between the areas of interest.



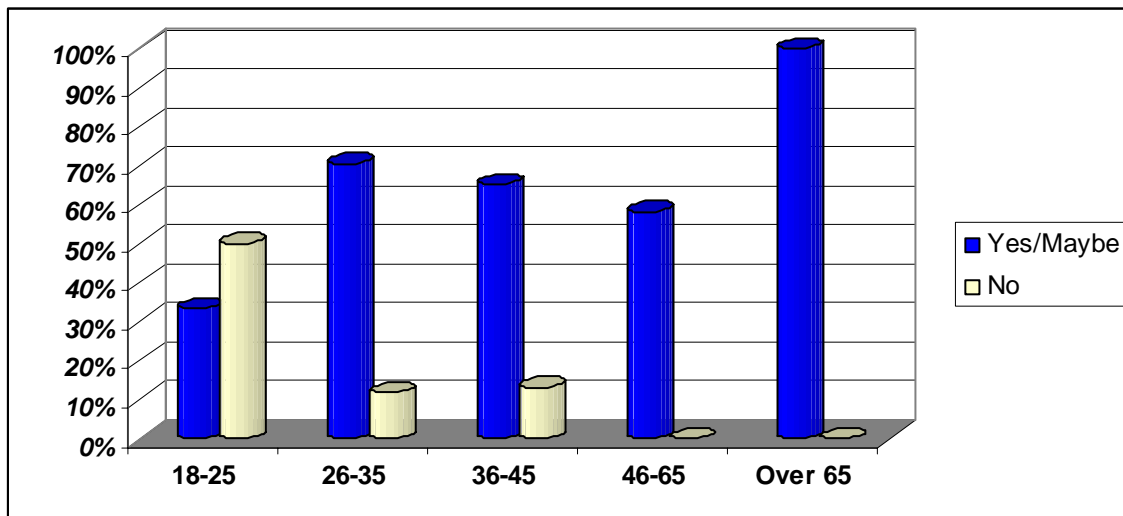
**Figure 4.1** Respondent Plans for Commuting (n=96)

## 5. Results and Findings

This section presents some of the key survey findings. It begins with a demographic overview of respondents and is followed by respondent travel behaviors. The cost effectiveness is then discussed highlighting a comparison between driving your own vehicle versus utilizing commuter bus service for traveling purposes. The travel characteristics of respondents are then discussed followed by a summary of the findings.

### 5.1 Demographics

The questionnaire asked the respondents a few questions regarding demographic data. The most prevalent age group was identified as those between the ages of 36 and 45, indicated by 23 respondents (38%). Not surprisingly the next largest response came from the 26-35 age group with 17 responses (28%), followed by the 46-65 age group with 12 responses (20%) and the 18-25 age group with 6 responses (10%). Two respondents indicated ages that were above 65. Figure 5.1 illustrates the willingness of the separate age groups to use the bus service. The respondents' willingness to use the service was based on question four from the survey, which asked if each respondent would use a direct service between the F-M and W-B areas if the monthly fare was between \$100 and \$160 and the daily round-trip fare was between \$7 and \$10. The figure does not show those individuals who indicated that they needed more information; however, the percentages below are based on the total number in each respective age grouping.



**Figure 5.1** Age Groups and Willingness to Use Commuter Service (n=60)

Survey respondents were also asked to indicate their highest attained education level. Fifty-three percent (32) of the respondents indicated they had obtained a bachelor's degree, 30% (18) of the respondents indicated completion of a trade/technical/junior college, whereas 8% indicated high school completion. Seven percent responded that they had received a graduate degree, and one individual indicated less than high school education attainment. When compared with the response given to question four, the use of an "express bus" for a fee, all individuals from the less than high school, high school, and graduate degree

education levels responded positively. One person, aged 18, with a two-year college education indicated no, and only seven of the 32 who indicated holding a bachelor’s degree indicated that they would not ride the “express bus” for a fee.

Along with age and education level, the questionnaire asked the respondents to indicate their level of income. Six separate categories were provided. Nearly half of the respondents indicated that they earned more than \$50,000 per year, followed by the \$30,001-\$40,000 with 15%, \$40,001-\$50,000 and \$20,001-\$30,000 with 13% each, below \$10,000 with 8%, and \$10,001-\$20,000 was the lowest indication with two respondents or 3% indicating this level.

## 5.2 Travel Behavior

Part of understanding the reason why people will use commuter service is becoming aware of what motivates them to travel. For the purposes of an “express bus” between the areas of Fargo-Moorhead and Wahpeton-Breckenridge, the survey respondents were asked what reasons were prevalent in their travels to one of these areas. Figure 5.2 shows the choices that survey respondents were given. Of these choices, employment had the largest response with 87% or 52 of the 60 respondents identifying this as their reason for travel. Employment was followed by shopping with 20 respondents, other with 11 respondents, and attending college with 7 respondents, respectively.

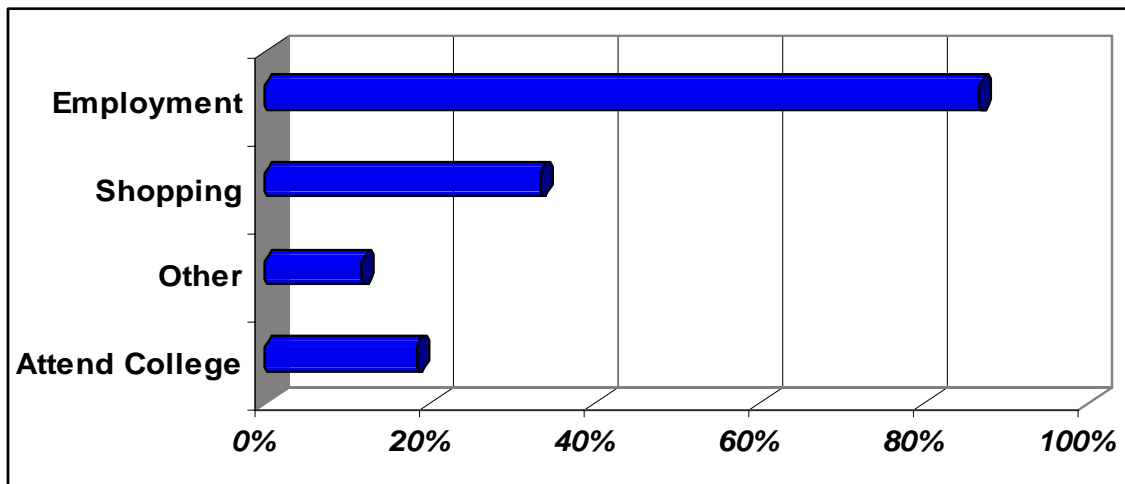
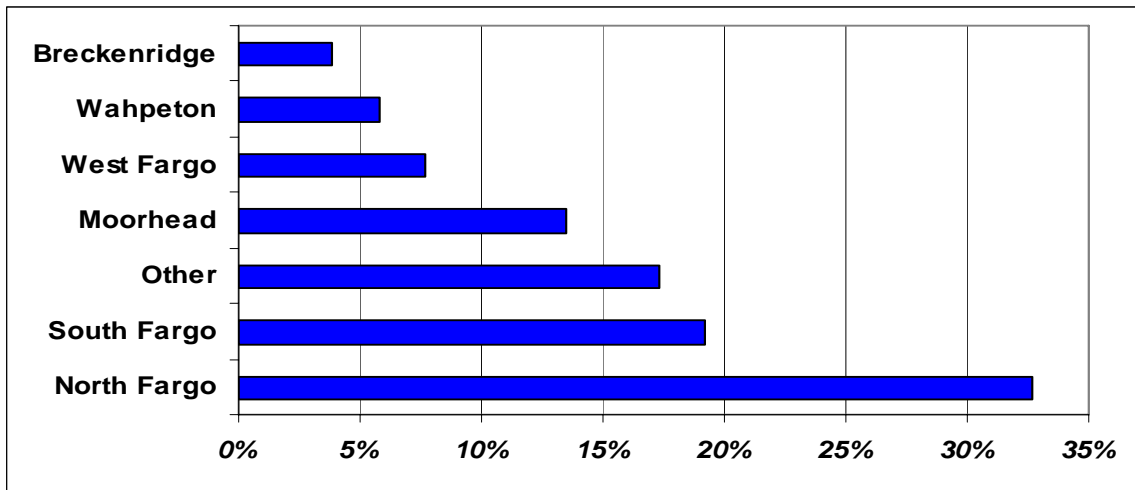


Figure 5.2 Reasons for Traveling to the F-M or W-B areas (n=60)

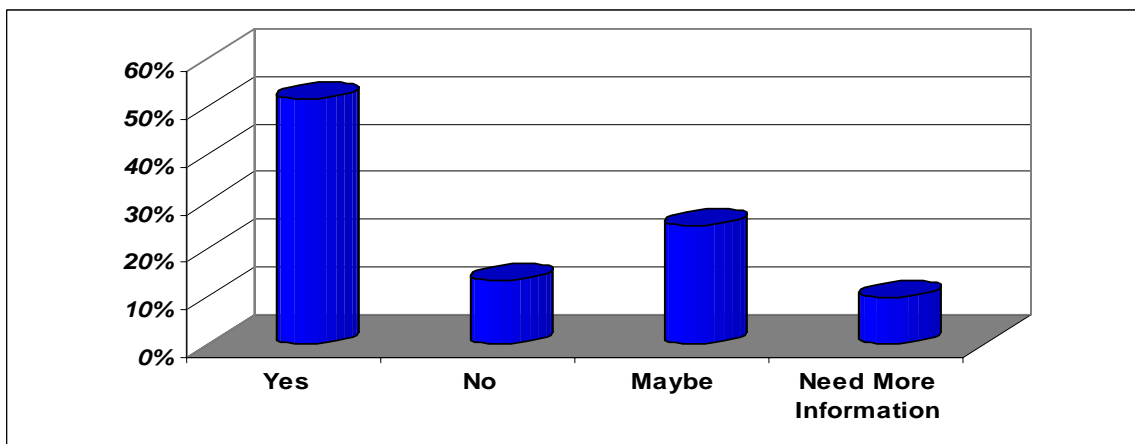


A large majority of the respondents indicated that they traveled for employment reasons. The question was then asked, if traveling for employment, where do you work? Figure 5.3 breaks down the most prominent areas in which the respondents work. As can be seen in the figure a great majority of the respondents work in the F-M area. Fargo locations alone amount to 60%, and the number increases to 73% when Moorhead is added. The Wahpeton-Breckenridge area totals 10%; 17% of respondents indicated other as their location of employment.



**Figure 5.3** Location of Employment (n=52)

Finding oneself without transportation during emergency situations is a deterrent to using public transportation for many individuals. Over half of the respondents indicated that they would be more willing to use the service if a guaranteed ride was available. This ride would most likely be in the form of a taxi. Figure 5.4 shows the willingness to use the service with an emergency ride guaranteed. Only 13%, or 10 respondents, indicated that this would not influence the likelihood of using such a service.



**Figure 5.4** Willingness to Use Service with a Guaranteed Ride (n=60)

Respondents were also asked to identify factors that would keep them from using the service. Figure 5.5 shows the most prominent response was that the service did not fit their schedule; with nearly half of respondents indicating this would be the main reason keeping them from using the service. Inconvenience and financial concerns are the next two biggest concerns, each being identified by 30% of the respondents. Twelve percent indicated that there are other reasons that would keep them from using the service. (However, multiple times throughout the questionnaire respondents indicated the need for more information. As more information is available, these reasons may decrease.)

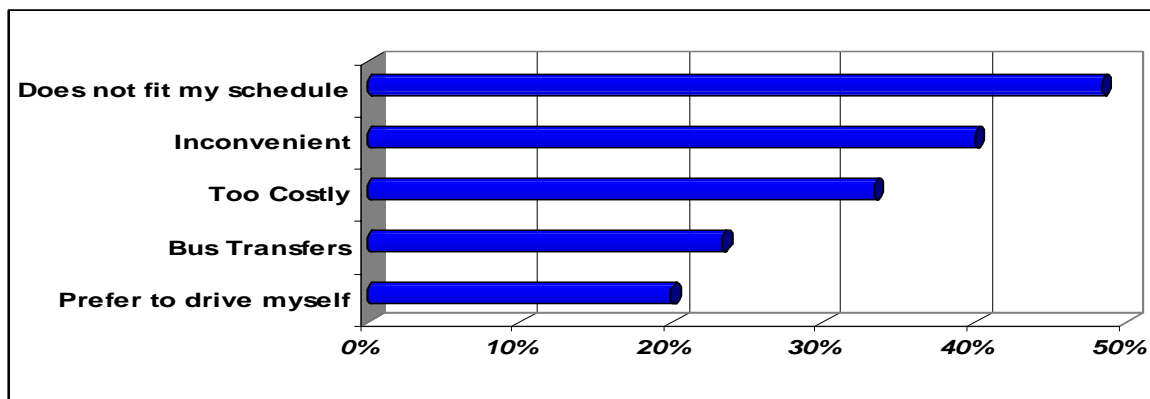


Figure 5.5 Reasons for Non-Use (n=60)

### 5.3 Cost Effectiveness

Based on data from Runzheimer International, the American Automobile Association developed *Your Driving Costs 2003* which is presented in Table 5.1. The table illustrates the vehicle costs associated with operating a vehicle. In this case, the numbers equate to the equivalent of driving between the Fargo-Moorhead and Wahpeton-Breckenridge areas. Traveling between Wahpeton-Breckenridge and Fargo-Moorhead equates to driving approximately 100 miles round trip. The total average cost for commuting daily between Wahpeton-Breckenridge and Fargo-Moorhead is approximately \$1,000 per month (\$0.50/mile x 100 miles x 20 days = \$1,000/month).

Related savings can be realized only if using the service allows the rider to eliminate the need for the vehicle. If, however, the rider will still need the vehicle for other personal use, savings will be significantly lower – probably equal to the variable per-mile cost of operation plus a portion of projected depreciation costs. Using a medium-size car: 11.5 cents x 2,100 miles per month x 12 months = \$2,898 plus maybe half of the depreciation amount = \$4,423 yearly or approximately \$369 per month.

This data, which was presented in the questionnaire, aimed at providing the respondents with supplemental data to assist them in detailing typical operating costs. With awareness of what typical operating costs were, the respondents had more information regarding their willingness to use an “express bus” service for a fee, either on a monthly or daily basis. Cost can be a considerable determinant in choosing a mode of transportation; this data develops a cost comparison between modes.

The data in Table 5.1, using 2003 data, does not take into account the increase in fuel prices over the past couple of years. The average U.S. fuel price in 2003 was \$1.65 per gallon. Currently, the average fuel price in the U.S. is \$2.61 per gallon, as of August 22, 2005 (Energy Information Administration, 2005) This substantial increase in fuel prices would lead to a 4- to 5-cent increase in the overall cost per mile

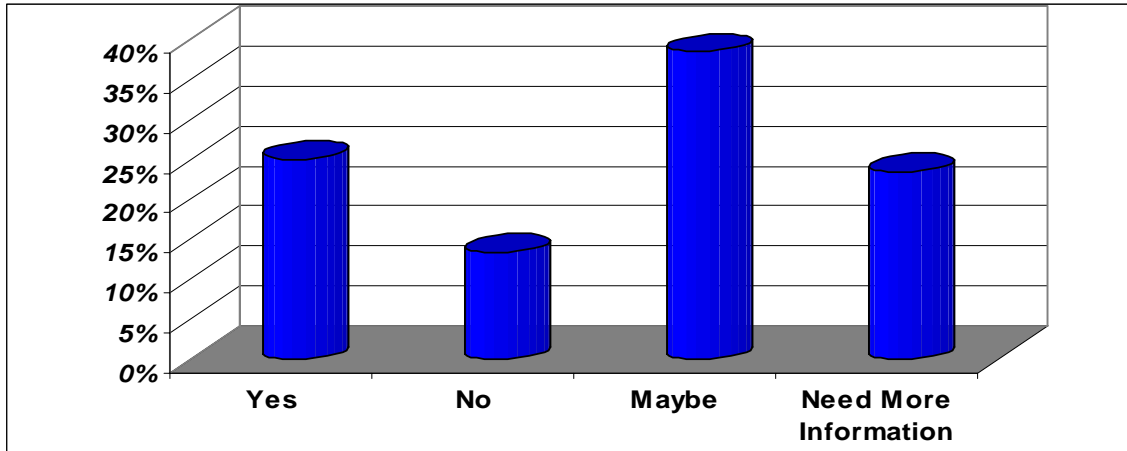
statistics found in Table 5.1. For example, driving a large car would no longer cost \$0.59 per mile as indicated in Table 5.1, but rather \$0.64 cents per mile, increasing the feasibility of utilizing express bus service for daily commutes. Also, the fuel price is a direct cost that is experienced every time someone refills their car with gas. It is not an indirect cost such as depreciation due to increased mileage decreasing the useful life of a vehicle. Depreciation costs are only realized by a driver when a vehicle is purchased or sold. Therefore, an increase in the price of gas at the pump will have a greater effect on a commuter's tendency to ride an express bus than an equal loss in resale value due to the accelerated depreciation of a vehicle.

**Table 5.1.** American Automobile Association Vehicle Cost Estimates

|   | <b>Medium Car</b><br>(Cavalier LS) | <b>Large Car</b><br>(Taurus SE) | <b>SUV</b><br>(Blazer) | <b>Van</b><br>(Caravan SE) |
|---|------------------------------------|---------------------------------|------------------------|----------------------------|
| Gas & oil                                 | 6.1¢                               | 7.1¢                            | 7.9¢                   | 7.1¢                       |
| Maintenance                               | 3.9¢                               | 4.1¢                            | 4.1¢                   | 3.9¢                       |
| Tires                                     | 1.5¢                               | 1.8¢                            | 1.5¢                   | 1.6¢                       |
| <b>Operating costs/mile</b>               | <b>11.5¢</b>                       | <b>13.0¢</b>                    | <b>13.5¢</b>           | <b>12.6¢</b>               |
| Insurance                                 | \$181                              | \$1075                          | \$950                  | \$873                      |
| License & registration                    | \$167                              | \$206                           | \$289                  | \$259                      |
| Depreciation                              | \$3,051                            | \$3,693                         | \$4,286                | \$3,772                    |
| Financing                                 | \$554                              | \$751                           | \$867                  | \$755                      |
| <b>Ownership cost/year</b>                | <b>\$3,953</b>                     | <b>\$5,725</b>                  | <b>\$6,392</b>         | <b>\$5,659</b>             |
| <b>Total cost for 12,500 annual miles</b> | <b>\$5,391</b>                     | <b>\$7,350</b>                  | <b>\$8,080</b>         | <b>\$7,234</b>             |
| <b>Average cost/mile</b>                  | <b>\$0.43</b>                      | <b>\$0.59</b>                   | <b>\$0.65</b>          | <b>\$0.58</b>              |

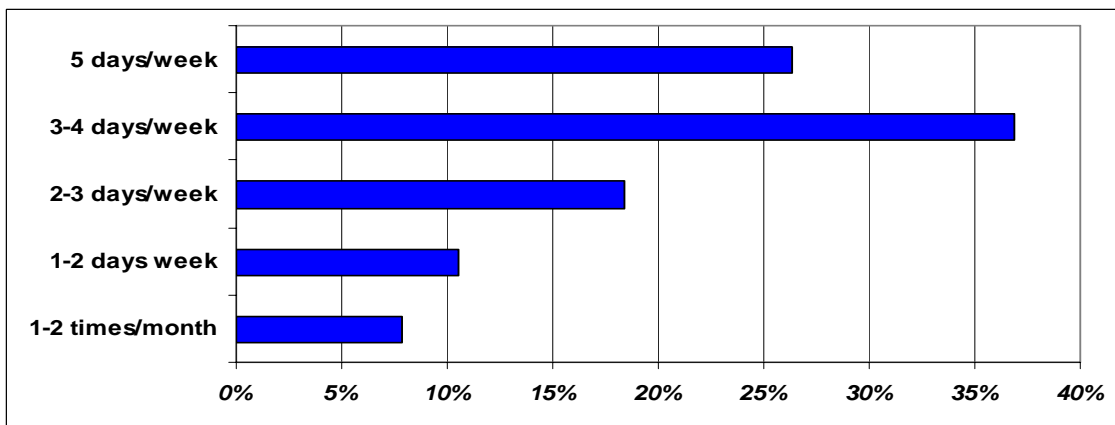
(Energy Information Association, 2005)

After considering the vehicle operation estimates, respondents were asked if they would ride an express bus that has direct service between Fargo-Moorhead and Wahpeton-Breckenridge if the monthly fare was between \$100 and \$150 and the daily round-trip fare was between \$7 and \$10. Only eight of the respondents (13%) indicated no, that they would not use the service. Figure 5.6 provides a visual of the responses to the question. As shown, one-fourth of the respondents indicated that they would use such a service, with 15 responding yes. Maybe was the most prominent answer given with 23 respondents indicating so, making up 38% of the responses, and the other one-fourth of respondents indicated that they needed more information.



**Figure 5.6** Willingness to Use Express Bus (n=60)

Those who responded yes or maybe to using the service were then asked how often they would ride. Figure 5.7 displays how frequently the respondents felt they would use the service. Most respondents indicated that they would use the service, with 26% indicating they would use it five days per week and 37% indicating three-four days per week. Eighteen percent responded with two-three days per week, 11% indicated one-two days per week, and 8% responded that they would use the service one-two times per month. It is evident that those who indicated they would, or maybe would, use such a service also indicated that they would use it on a frequent basis with 63% showing responses of three days per week or more.



**Figure 5.7** Frequency to Service Use (n=38)

Related factors in determining the cost effectiveness of the two modes include whether or not potential users receive a transportation stipend or if a parking permit is necessary. The vast majority of respondents do not receive a stipend or subsidy from their employers and most are not required to purchase a parking permit. Ninety-two percent do not receive a stipend, while only 5% indicated receiving some sort of subsidy for travel. Eighteen percent, 11 respondents indicated the need to purchase a parking permit, while over 70% (8) of the 11 indicated the cost was less than \$20 a month.

## 5.4 Travel Periods

Most respondents indicated that they traveled between the Fargo-Moorhead and Wahpeton-Breckenridge areas primarily for work though other purposes, such as shopping, were identified. To schedule a service such as an express bus, it is helpful to know when people need to travel. The survey included questions related to what times individuals needed to be at work, what time individuals departed from work, as well as what times individuals would use an express bus for reasons other than employment. Figure 5.8 shows the times respondents indicated they needed to arrive at work. Figure 5.9 shows the times respondents indicated as their departure times from work, and Figure 5.10 displays the times that respondents would most likely ride the service for events other than work.

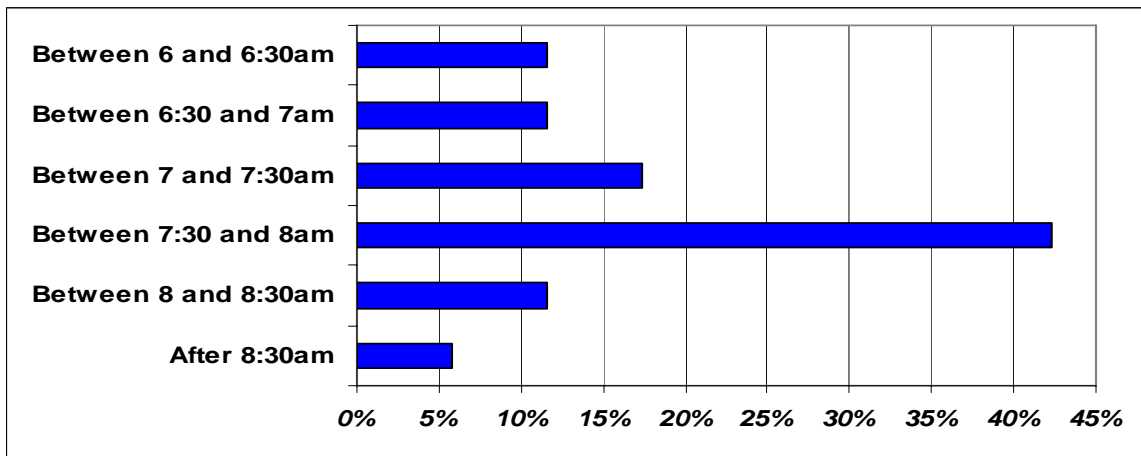


Figure 5.8 Time to Arrive at Work (n=52)

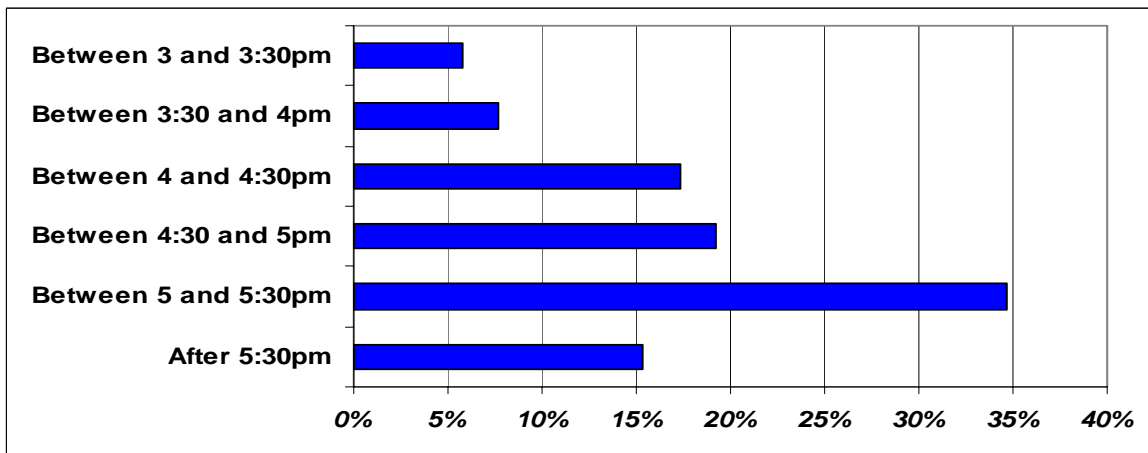
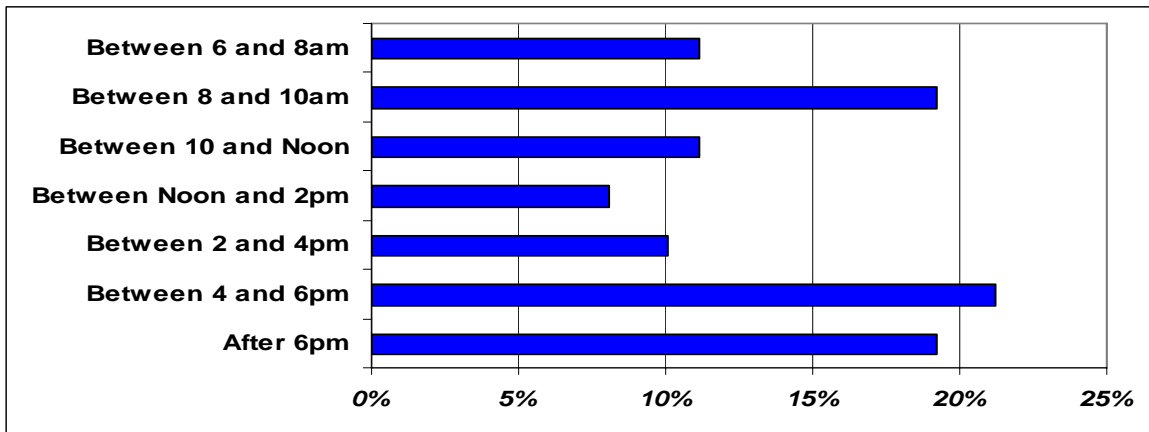
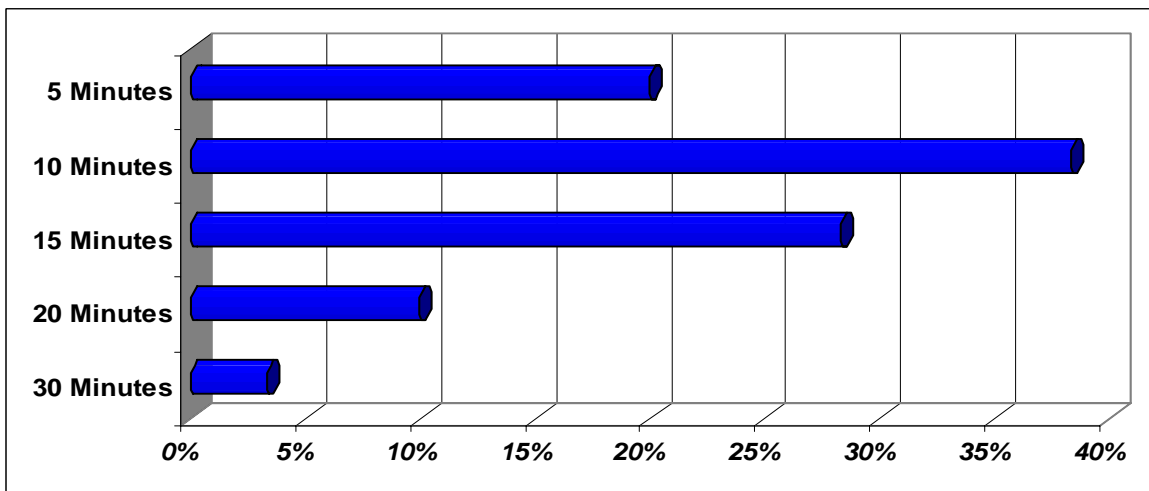


Figure 5.9 Time of Departure from Work (n=52)



**Figure 5.10** Ride Times for Events other than Work (n=60)

The majority of respondents seem to follow the traditional 8 a.m.-5 p.m. work schedule, and ride times for events other than work seem to be more heavily weighted in the mornings and late-afternoon to early-evening. However, with the differing schedules and locations of employment, bus transfers are inevitable. Taking this into consideration, respondents were asked how long they would be willing to wait for a free transfer between the express bus and a Fargo-Moorhead Metropolitan Area Transit (MAT) Bus. Figure 5.11 shows that people, as expected, were not willing to wait extended periods of time for bus transfers. Nearly 90% are willing to wait only 15 minutes or less, with 97% willing to wait 20 minutes or less.



**Figure 5.11** Acceptable Wait Times (n=60)

## 5.5 New Service Experiences

The Wahpeton-Breckenridge commuter route started in October 2005 with three riders. The peak saw six monthly pass riders but to date two riders are using the service (one from Wahpeton and one from Wolverton). The feedback received has included several commuters who were going to ride to Blue Cross/Blue Shield and the Veterans Hospital. The Veterans Hospital routes only run every hour from the Metro Area Transit (MAT) Ground Transportation Center (GTC), so several had a long wait at the GTC, or had to be at work by 7:30 a.m. and couldn't make the connection. Other commuters from the Detroit Lakes route quit because of the MAT Veterans Hospital route as well.

As of October 1, 2005, Clay Country Rural Transit (CCRT) ceased delivering commuters door-to-door and started utilizing the GTC and MAT bus system for commuters to transfer and get to work. The Blue Cross/Blue Shield employees do not have a MAT route that meets their needs and riders from both the Detroit Lakes and Wahpeton routes no longer use the commuter service. They would get to work late and have to leave early to catch the CCRT bus at the GTC. The four entities (Wilkin, Wahpeton, Breckenridge and Wilkin) all gave an additional \$750 each for another three-month period in an attempt to increase ridership within the next three months (January-March). Utility bill stuffers in both cities (Wahpeton-Breckenridge) are being done this month, along with some "free" TV and paid radio advertising. \$140 per month is the pass cost and Ms. Beaudry believes that the decrease in gas prices over the past few months has hurt ridership as well. The governmental entities to the Wahpeton-Breckenridge area have been very supportive of the route, but less interest and support has been seen by Fargo-Moorhead entities (Beaudry, 2006).

## 5.6 Summary

The questionnaire data provided some positive feedback for an express bus service. Of those who responded, only 13% said that they would not use the service. Also, if a guaranteed ride is available, such as a taxi, the 25% who indicated they would use the service rose to nearly 50%. The majority of respondents commute between the Fargo-Moorhead and Wahpeton-Breckenridge areas quite frequently, as most travel more than three days per week. As expected, most individuals do not want to wait long for bus transfers. However, providing more information on the system should make users more conducive to the idea. The actual implementation of the service between Fargo-Moorhead and Wahpeton-Breckenridge has seen low ridership. Marketing techniques are continually being used to increase awareness for the route, but inefficient transfers between the commuter service and the Fargo-Moorhead local bus service are to be the primary obstacle to increased ridership.





## 6. Conclusions and Recommendations

Education will be the main factor influencing express bus service in North Dakota. Nearly all commuters are unfamiliar with the service and its features. Most, if not all, North Dakotans and western Minnesotans have grown up utilizing personal automobiles for their travel needs. They do not demand alternative transportation service unless it is necessary due to a physical or mental deficiency. This is a main reason public transportation in North Dakota and western Minnesota is viewed as an exclusive service for the handicapped and elderly.

Responses to this study's survey do show that commuters would be receptive to using commuter service if it were available. Most respondents indicated they travel between Wahpeton-Breckenridge and Fargo-Moorhead for employment. The primary goal of a commuter route connecting the communities should then focus on work force commuting. The first functioning routes should focus on transporting employees from their residences to the place of employment early in the morning and home again in the late afternoon. After these routes have been successfully established, more may be added if adequate demand is present.

Convenience is another key factor influencing commuter bus ridership. To persuade commuters to relinquish the convenience of their own automobile, a guaranteed ride home should be offered, at least initially. An often-used excuse for not utilizing public transportation is its lack of convenience. This provides another reason to have the guaranteed ride available to daily commuters providing them with the convenience they demand.

Finally, survey results indicated that most potential commuter service users would be unwilling to wait for a transfer of more than 10 minutes to the Fargo-Moorhead MAT fixed-route service. To satisfy this request, the commuter service must synchronize its schedule with that of MAT. This will require planning and experimenting with different schedules and travel patterns of both services. Careful attention must be paid to this aspect of the service as riders will not tolerate long wait periods when transferring between the two systems.



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# Appendix A: Background on Bus Rapid Transit and Political Frameworks

## 1. Bus Rapid Transit and Political Feasibility Background Information

This appendix serves as a companion document to the express bus study for individuals who want to learn more about bus rapid transit including the history, what is happening in the United States as well as internationally, and the political aspects of it. First, a definition, characteristics, and strengths and weaknesses are documented. Second, an extensive literature review is included which looks at BRT history in the United States, BRT international experiences, as well as BRT research studies. The research studies are categorized as ridership and behavioral and equipment and bus types. Third, political frameworks that could be used to address the political feasibility of BRT are provided.

### 1.1 Introduction

Several large cities have applied for federal grant monies to introduce light rail systems into their communities. In the past 20 years, 12 light rail systems have been introduced into the United States, yet the funding for light rail systems and subways is so high the federal government cannot finance all of the applications it receives from cities wanting to build light rail systems. As a result, in 1998, with the passing of transportation legislation, TEA 21, the Federal Transit Administration (FTA) has been appropriated funding to develop Bus Rapid Transit (BRT) demonstration projects in the United States. BRT is viewed as a low-cost alternative to light rail systems. FTA views BRT as a way to improve public transportation systems by utilizing the scarce resources in more innovative ways.

Bus Rapid Transit makes use of specific features such as designated lanes, signal priority, and larger buses with fewer stops spaced further apart than regular transit stops to make the service more rapid. Bus Rapid Transit is not a new concept. The idea began to ruminate in the United States during the late 1950s and the 1960s by businessmen (Barnard, 1955), transportation planners (California Public Utilities Commission, 1957), and researchers (Crain, 1963). During the mid 1950s, Boyd Barnard suggested that cities should have separate lanes or separate streets for transit vehicles that would help alleviate downtown congestion (Barnard, p.3, 1955). BRT entails more than a separate transit lane as will be explained, but these ideas were the early prototypes of Bus Rapid Transit (BRT). The topic of BRT remained topical through the 1970s (Levinson and Sanders, 1974; Meier, Vederoff, and Porter, 1974; Bennet 1976; Schneider and Clark, 1976; and Crain, 1975). International busways were also developed in the 1970s including those in Curitiba, Brazil and Ottawa, Canada. Both busways are in operation today and serve as model BRT systems for the world. There has been a resurgent interest in the United States for Bus Rapid Transit systems.

## 1.2 What is Bus Rapid Transit (BRT)?

BRT is different from conventional bus transit as it combines technology, the operating plan, and the customer interface to create high-quality service transit systems (Diaz and Schneck, 2000). The Transit Cooperative Research Program (TCRP) A-23 Committee developed a more formal definition of BRT, which is:

*Bus Rapid Transit (BRT) is a flexible form of rapid transit that combines transit stations, vehicles, services, running way, and ITS elements into an integrated system appropriate to the market it serves and its physical environment. BRT can use vehicles that may be driver-steered, guided mechanically or electronically. A great advantage is that it can be incrementally implemented in a variety of environments, from totally dedicated to transit (surface, elevated, underground) or mixed with other traffic on streets and highways.*

Not all of the BRT systems that are operational within the United States and abroad include all of the technologies or attributes available for BRT systems. The attributes appear to play an important role in the increased quality and speed of service of the BRT system. The specific attributes will be presented in greater detail in Chapter 2 *The Literature Review*. There are no reports available that indicate which are the most important attributes.

In regions where light rail systems are too costly, but ridership warrants rapid systems, BRT is a viable alternative. For example, recently in Los Angeles the city evaluated the cost of implementing a bus rapid transit, light rail, or subway over 54 miles. The 54 miles of dedicated busway cost \$810 million, light rail cost \$4 billion and subway cost \$13.5 billion (USC Architectural Guild Forum, 2000). Clearly the busway requires the least investment to initiate operation indicating that BRT is a low-cost alternative to LRT. Essentially, BRT seems to be a low-cost alternative to light rail systems and a potential method to help reduce congestion in growing cities.

## 1.3 Today's BRT Characteristics

The five major elements the BRT systems encompass are 1) vehicles, 2) guideways, 3) control systems, 4) fare collection systems, and 5) passenger information systems. The systems may not have each of these elements, but they are likely to have all or some combination of them.

First, vehicles are the main element of BRT technology. Diaz and Schneck (2000) claim the vehicle technology affects the speed and reliability of transit service along with the comfort and user-friendliness. The vehicles sizes can range from the 30-40-foot buses to the full size articulated and biarticulated buses that can carry 270 passengers ([brt.volpe.dot.gov](http://brt.volpe.dot.gov)). Other vehicle features that are desirable for BRT systems are low floor buses, which essentially provide a low enough floor so steps are not required for riders to board the bus. Low floor buses were first deployed in December 1991 and have become the choice of transit agencies in both the U.S. and Canada (King 1998). In 1997, there were over 2,800 standard and large-size low floor buses and another 2,660 were on order. These buses are expected to provide an easier and friendlier access for all passengers. The buses also meet the Americans with Disabilities Act (ADA) accessibility requirements and provide service for the growing elderly customers. Likewise, some transit systems, particularly BRT systems are opting to use wider doors as well as doors on each side of the vehicle to allow for faster entry and exit.

Second, guideways and right-of-way are important to BRT. The guideway or roadway operations can range between dedicated lanes which are lanes used only for BRT, and semi-dedicated lanes which are primarily dedicated to transit but because of the topology the lanes are shared with non-transit vehicles such as center-city bus or trolley lanes that cars and trucks use to make left-hand turns or right-hand turns when the transit lane is on the right side of the road such as the Boston Silver Line on Washington Street (Mitretek Systems 2000). Another is the expressway operation that relates to express buses operating on expressways such as HOV lanes. The services could include tollbooth bypass lanes and ramp metering bypass lanes. Buses can operate at speeds up to 65 mph. The Pittsburgh north line offers this service. A variation of this occurs in Minneapolis where buses are allowed to 'queue jump' on the 10-foot-wide shoulder when congestion is encountered (Mitretek 2000).

Third, the element of control systems identified by Diaz and Schneck (2000) is similar to the element of corridor and street operations identified by Mitretek (2000). Each of these refers to methods to speed up bus service on normal streets. BRT control system technologies may include dispatching and also signaling. The dispatching element provides instruction to operators for the start of the runs of the vehicles that would ensure greater service reliability (Diaz and Schneck 2000). The priority portion of the control system refers more to the corridor and street operations including signaling systems that gives priority to transit vehicles in mixed roadway rights-of-way. Mitretek (2000) lists the services to include: signal prioritization, signal preemption, queue jumper lanes, and pullout right-of-way.

*Signal Prioritization* - is giving priority to transit vehicles or emergency vehicles or allowing them to proceed first at signalized intersections. Sensors or communications notify the signal controller that a bus is approaching and the signal is either held green an extra few seconds or the signal changes from red to green a few seconds earlier. This could increase throughput of an intersection since transit vehicles can move many people.

*Signal Preemption* - with signal preemption, a sensor or communications notify the signal controller and the signal is held green until the bus passes through.

*Queue Jumper Lanes*- at intersections the bus is given either the far right or far left lane exclusively. As a bus approaches a congested intersection it will have its own lane so it will be able to bypass the waiting traffic in regular lanes. The bus is given a green light a few seconds before the other traffic that allows the bus to get in front of the other traffic.

*Pullout Right-of-Way*- in this case, the buses are given the right-of-way to pull out from the curb. Recently this was enacted law in Alameda County. Special signs are used on the back of the bus in addition to necessary public education about this new law. This enables buses to move ahead faster (Mitretek 2000).

Fourth, *fare collection systems* can help to expedite passenger boardings as well as reduce need for transfers. Some transit systems may require exact fare if the fare is collected on the bus. Another approach which would speed up the collection of fares is to have a station-based fare collection where the fare is paid at the station before the rider enters the vehicle.

Fifth, passenger information systems provide real-time information such as when the next bus will arrive, or hours of service or frequency of service provides relevant information to passengers and allows them to make more informed decisions. Much of this information can be captured through the use of automatic vehicle locators (AVL).

Mitretek Systems developed a report for the Federal Transit Administration entitled *Bus Rapid Transit (BRT) Vehicle Characteristics* (2000). Within the document, it lists BRT system goals that FTA should seek. They include:

- Shorter trip times between origin and destination—fewer stops, faster travel, less congestion.
- Short wait between vehicles—more frequent service, even spacing between vehicles
- accessible—convenient to parking, other transportation modes including neighborhood bus service and bicycles
- Distinctive—modern, distinctive design for vehicles and stations
- Easy to use—easy and rapid embarkation and debarkation, simple fare collection, and clear signage.
- Welcoming—comfortable vehicle interior designed for both seating and standing, clean, affordable service (in line with other transit services).
- Low emissions—part of the modern image is low emissions and low noise.

## 1.4 Strengths and Weaknesses of BRT

There are both strengths and weaknesses to implementing a BRT system. In 1975, Crain identified benefits and weaknesses for that era. Crain viewed the benefits to the busway as first, a form of rapid transit as an alternative to rail because it was less costly to build than a suburban-to downtown line-haul facility. Second, it can be built more quickly than rail, somewhere between two to five years. Third, it is more flexible since the vehicles can leave their fixed right-of-way to collect and distribute riders. Fourth, routes and schedules can be changed more easily. Fifth, Crain sited that funds could most likely be obtained from federal and state agencies to construct the busway facility. The uncertainties facing the busways were the cost of a grade separation downtown had not been determined and could pose problems that would not face rail. Furthermore, Crain identified that bus rapid transit did not have the room for riders to move around, large seating areas, nor the smoothness of ride which was inherent to the train. Finally, people view the bus as an undesirable alternative to auto or train because of the unreliable schedule, frequent stops and starts, and crowded and uncomfortable conditions (Crain 1975).

Stefano Viggiano, with Lane Transit's Eugene- Springfield area BRT system has sited strengths and weaknesses to the BRT system it will be implementing. They include:

- Strengths (Viggiano of Eugene, Oregon )
  - capacity and speed
  - flexibility and diversity
  - affordability
  - incremental development
  - implementation speed
  - self-enforcement
- Weaknesses (Viggiano)
  - institutional fragmentation
  - lack of political visibility
  - apparent complexity
  - impact on other traffic
  - severance
  - land-related impacts



The strengths and weaknesses can be applied to each community. The impact of the strength or weakness may vary among communities and the politics involved within each community is partially responsible. This is one reason political feasibility of BRT systems is important to evaluate. The next section looks at the literature of political feasibility as well as institutional barriers relevant to BRT.

## 2. REVIEW OF LITERATURE

### 2.1 BRT History in the United States

The first BRT demonstration project in the U.S. began in the early 1970s. Seattle had experienced vigorous growth during the 1960s that resulted in increased congestion. The city officials began searching for a solution and the BRT demonstration project was conceived by Seattle Transit System in 1966. "Blue Streak" BRT system was implemented in 1970 (Voorhees and Associates, Inc. 1973). The buses in the system used I-5 reversible roadway in the peak direction and had exclusive use of the Columbia-Cherry Street on-off ramp in the southern part of the Seattle central business district. Service was provided to and from park-ride lot eight miles north of downtown. Buses would travel their regular route and enter or leave the reversible roadway at appropriate ramps. The buses were able to take advantage of the faster freeway travel rather than using local arterial routes.

In addition to busways, during the 1970s was the development of High Occupancy Vehicles (HOV) facilities in the U.S. (FTA Issues in Public Transit 1998). Intermingling began to occur with the HOV and busways. Exclusive busways or bus lanes were opened on the Shirley Highway in the Washington, D.C., area, the El Monte Freeway in Los Angeles, the I-495 approach to the Lincoln Tunnel in New Jersey, California Highway 101 in the San Francisco metropolitan area, and a separate right-of-way in Pittsburgh (FTA, 1998). HOV lanes opened also to vanpools and carpools and were created on highways serving New York, Los Angeles, Seattle, San Francisco, Washington, D.C., and Honolulu.

In the 1980s, most of the early exclusive bus lanes were converted to HOV lanes, with the exception of the I-495 lane in New Jersey and the Pittsburgh busway. However, bus lanes were introduced on New York City's Madison Avenue on May 26, 1981, reducing bus travel times by 34 to 42 % and increasing ridership by 10 % (<http://brt.volpe.dot.gov/issues/pt2.html>).

During the 1980s the number of freeway HOV route miles increased by over 100 % (FTA, 1998 p. 6) Some of the HOV lanes were discontinued due to low usage or public opposition, in which case the course terminated the Santa Monica Freeway HOV treatment. In the United States, there are presently over 80 HOV facilities that are longer than 3.5 miles (FTA, 1998 p. 6).

Texas has also been using HOV express buses with Houston's Metropolitan Transit Authority of Harris County (Houston Metro) operating 86.4 miles of freeway HOV lanes on six city corridors. The HOV lanes carry approximately 85,000 passengers per day and it is estimated to expand to over 120 miles by the end of 2000. Likewise, Dallas Area Rapid Transit (DART) has embarked on an express bus service on HOV lanes. There are 18 miles of HOV lanes in operation and DART plans to expand the network into 110 miles of HOV ([www.dart.org/home.htm](http://www.dart.org/home.htm) April 25, 2000, as in Miller and Buckley p. 9).

Kain (1999) looked at the costs of HOV and express lanes and their use together to share excess capacity. Kain stated that it is not necessarily better to always build shared bus-HOV facilities than exclusive busways. Shared bus-HOV facilities with on-line stations may create engineering, safety, and operational

problems and may significantly increase capital costs. Kain concludes that where transit demand is large enough to use a much of the exclusive busway's capacity, there may be good reasons for keeping the busway exclusive.

## **2.2 BRT International Experiences**

International BRT systems were also constructed during the 1970s. Two of the most prominent systems include Curitiba, Brazil, and Ottawa, Canada. Both systems are still in operation today and serve as international BRT models for the world. The system in place in Rouen, France, is becoming recognized as a model system as well. In Rouen, land-use planning is more challenging because much of the city has already been developed. Future growth can be planned around the system, however, the city did not have the ease of developing around transit arteries.

### **2.2.1. Curitiba, Brazil**

The Federal Transit Administration views Curitiba Brazil as a model Bus Rapid Transit system that plays a large role in making Curitiba a liveable city ([VRT.Volpe.dot.gov/issues/pt3.html](http://VRT.Volpe.dot.gov/issues/pt3.html), 2/6/01). The bus system evolved because over 30 years ago Curitiba had forward thinking and cost-conscious planners that developed a master plan and integrated a BRT system into the plan. As a result of the master plan of 1965, Curitiba's rapid growth would occur in a linear form along designated corridors rather than in all directions (FTA, 1998). In the 1960s, Curitiba considered building a light rail system, but it was too expensive. Implementing an underground metro was priced at approximately (in 1965 United States dollars) \$60 million to \$70 million per kilometer or \$94 million to \$113 million per mile, however an express bus road would cost only \$200,000 per kilometer or \$323,000 per mile (Rabinovitch and Hoehn, 1995).

In Curitiba, buses run along dedicated and exclusive lanes and stop at tube stations. The stations are designed cylindrical-shaped, clear walled stations with turnstiles, steps, and wheelchair lifts. Passengers pay their fare when they enter the station rather than when they enter the bus. Buses are designed with extra wide doors and ramps that extend when the doors open and fill the gap between the bus and the station platform rather than having passengers take steps to board the bus. Curitiba's BRT system is much like a subway system with speed, efficiency, and reliability. The system makes use of the following technologies to provide exceptional service:

- integrated planning
- exclusive bus lanes
- signal priority for buses
- pre-boarding fare collection
- level bus boarding from raised platforms in tube stations
- free transfers between lines (single entry)
- large capacity articulated and bi-articulated wide-door buses
- overlapping system of bus services (FTA, 1998).

Curitiba has 10 private bus companies that provide all the public transportation services but the city sets the parameters. The bus companies are paid by the distance they travel rather than by the passengers the buses carry. Interestingly, all of the buses earn an operating profit ([brt.volpe.dot.gov/issues/pt3.html](http://brt.volpe.dot.gov/issues/pt3.html)). The city does pay the bus companies about 1 % of the bus value per month. The city takes control of the buses after 10 years and uses them for transportation to parks or as mobile schools. Most of the buses are relatively new, only about three years old because of the newly designed buses, which adopted new

technologies including the articulated and bi-articulated buses ([brt.volpe.dot.gov/issues/pt3.html](http://brt.volpe.dot.gov/issues/pt3.html)). Bi-articulated buses are three buses attached by two articulations and are capable of carrying 270 passengers (Birk and Zegras, 1973 as found on [solsice.crest.org/sustainable/curitiba/part4.html](http://solsice.crest.org/sustainable/curitiba/part4.html))

Land use planning has played a crucial role in the success of Curitiba's BRT system. The city anticipated growth and limited central area growth and encouraged commercial growth along the transport corridors from the central portion of the city. Between 1973 and 1978, Curitiba's population grew by 73 %. At the same time, Curitiba built three main transit arteries and the population growth around the arteries grew by 120 percent. The city's Master Plan provided economic support for urban development. The city emphasized community self-sufficiency and provided each city district with its own education, healthcare, recreation, and park areas. This contribution resulted in almost 40 % of Curitiba's population residing within three blocks of the major transit arteries by 1992 ([brt.volpe.dot.gov/issues/pt3.html](http://brt.volpe.dot.gov/issues/pt3.html)). Furthermore, land near transit arteries is encouraged to be developed with community-assisted housing. The Institute of Urban Research and Planning of Curitiba (IPPUC), which was established in the 1960s to oversee the Master Plan today, must still approve locations of new shopping centers. It channels new retail growth to transit corridors rather than to American style auto-oriented shopping centers. Parking is very limited and is time-sensitive downtown thus further encouraging use of public transportation (USC Architectural Guild Forum, Jaime Lerner's presentation 2000).

The results of Curitiba's BRT system have been commendable. The popularity of the BRT system has affected the modal shift from automobile travel to bus travel. Even though Curitiba has a high income and high rate of car ownership relative to the rest of Brazil, the residents still rely on BRT for transportation. A 1991 traveler survey showed that BRT had attracted enough auto users to public transportation to cause a reduction of about 27 million auto trips per year, saving about 27 million liters of fuel annually. Some 28 % of direct bus service users previously traveled by car. Curitiba uses about 30 % less fuel per capita than other Brazilian cities because of its heavy transit usage. Curitiba has one of the lowest ambient air pollution in Brazil and it is attributed to the public transportation system accounting for 55 % of private trips in the city ([brt.volpe.dot.gov/issues/pt3.html](http://brt.volpe.dot.gov/issues/pt3.html)).

### **2.2.2. Ottawa, Canada**

Ottawa, Canada, also implemented a "Transitway" in 1973 that made bus the backbone of the city's transit system consisting of 6.8 miles of bus lanes. Several busways were opened in 1983 with exclusive, grade-separated right-of-way (Miller and Buckley, 2000 p. 8). The system has expanded and today operates on 16 miles of exclusive right-of-way, approximately 7.8 miles of priority lanes, and operates for two miles in mixed traffic. The system has been very successful, making nearly 200,000 trips per day, and capable of carrying 10,000 riders per hour each direction (Miller and Buckley, 2000).

In many ways, the Ottawa Transitway resembles the conventional transit system:

- conventional bus length (standard and articulated)
- no low floors
- no wide doors
- two right-hand side doors and no left-hand side entry, i.e., no median entry
- no automatic stop: passengers must inform drivers of their desire to stop and exit
- entrance via front door depends on time-of-day and day-of-week, e.g. weekends
- on-vehicle fare collection (or show a paid-for-in-advance monthly fare card)
- only static information is available: published schedules, other routes, and route connection
- information is posted at bus stops and stations, not on board the bus
- Only on-board signs indicate the next stop has been requested and "EXIT AT REAR: sign
- Right-of-way allows mixing with non-bus vehicles in certain locations, e.g. in the Ottawa CBD.

- Ordinary bus stops/shelters exist along the route though are not indicated on the published website route map.

Yet, Ottawa Transitway has special features that help make it successful. For example, in the outlying areas, the Transitway has an exclusive bus lane usually with one lane per direction. However at the stations, the right-of-way is made up of two lanes each direction. The speed limits vary between 35 and 50 mph on the exclusive busway but slow to about 30 mph around the station areas. The Transitway has some infrastructure that makes it expensive, including bridge walkways from some stations to adjacent commercial office developments. One stop is right in front of a suburban mall. Ottawa has cold and snowy winters so the stations are enclosed to provide protection from the elements. At the present, Ottawa does not make use of advanced traveler information systems such as SmartCard technology or real-time information on arrivals, nor does it have communication systems linking the bus driver with a central operations center. Ottawa is viewed as another success story and several other Canadian cities have moved toward this special transit system including, Montreal, Quebec (Diaz and Schneck, 2000), and Vancouver (Miller and Buckley, 2000) to achieve greater bus performance.

## **2.3. BRT Research Studies**

### **2.3.1. Ridership and Behavioral Types of Studies**

A number of studies were conducted that focused on ridership profiles as well as what may influence individuals to ride the bus. Crain (1975) studied the San Bernardino Freeway Express Busway that he identified as the first busway in the United States. It was an 11-mile double-lane exclusive roadway for buses running east and west from downtown Los Angeles through a middle-income, suburban residential commute corridor. The eastern half of the busway was opened on January 29, 1973. The busway lanes were physically separated by concrete and flexible barriers from those lanes servicing the automobile traffic, which made it a bus rapid transit system (Crain 1975). This \$60 million BRT system was complete with online stations and double (bidirectional) bus lanes.

The main objective of the study was to determine if the bus placed into rapid transit service would be found attractive by the riding public. Time series data collected approximately every six months for bus ridership and traffic counts through the corridor. The data are plotted with identification of events in a time series manner. Annual household surveys were conducted once a year to determine which commuters are using which modes and submodes, socioeconomic profiles, time and cost of each mode used, reasons for using each mode and why they may have switched modes, and their attitudes toward and perceptions of the busway. Approximately every two years, on-board surveys were conducted to supplement the household surveys. These on-board surveys provide large samples and data on socio-economics and attitude-perceptions and origin-destinations of the busway users. After 18 months of operation, data collected indicated an acceptance of the busway by users and nonusers. Of all commuters interviewed during the fall household survey, 75% thought highly of the busway and 20% were negative and thought busway lanes were wrong, unsafe, or too costly. From January 1973 to June 1974, ridership went from 1,200 during the peak hours (5.5-hour period of morning inbound and evening outbound traffic) to 7,500 riders. Primary reasons riders gave for switching from auto to busway are found in Table 2.1.

| <b>Reason for Switching</b> | <b>Percent</b> |
|-----------------------------|----------------|
| Time, convenience           | 46             |
| Frustration with automobile | 18             |
| Cost savings                | 14             |
| Employment change           | 9              |
| No reason given             | 9              |
| Other                       | 4              |
| Source: Crain, 1975. P. 26. |                |

A ridership profile type of study was conducted by Mark et al. (1976) of the Express Bus, which has BRT attributes, in use in Honolulu. The express service was implemented in 1972. The study was conducted during 1972 and 1973 to provide the city and county of Honolulu with information on the morning ridership boarding at each bus stop in Hawaii Kai, the number of passengers disembarking at each destination stop and general ridership profile information. Both an on-board survey and a door-to door survey were conducted. Findings indicated that 1) express bus patronage was significantly higher than that of the prior bus service; 2) significant portion of morning riders did not use the service for the return trip; 3) the proportion of male and female riders was about even and predominant occupations were professional and technical; 4) about half of all riders came from household that owned two cars; 5) about 60 % of CBD riders and 40 % of riders on university route were former auto drivers. And 6) increase in patronage over the survey period were in part due to gasoline shortages and the groups most affected by the gasoline shortages were students.

### **2.1.2. Equipment and Bus Types of Studies**

Meier, et al (1974) conducted a study of the implementation of a regional bus rapid transit system in the Seattle area. They assessed if the Seattle area would support a BRT system by estimating costs and number of riders based on other systems. They concluded that node-oriented bus transit systems are potentially an economically feasible method for Puget Sound. However, the authors lacked operating data for a comparable system and had difficulty estimating operating costs.

A study conducted by Levinson and Sanders (1974) was commissioned to determine the minimum number of buses needed to warrant a bus lane or a contra lane. A person-delay model was developed and used to determine the feasibility and practicality for implementing a contraflow freeway bus lane in urban areas. The model dealt with peak-hour trips on a six-lane, two direction freeway. The authors found that with flows less than 3,600 vehicles per hour in the heavy direction, buses can continue to operate normally because their speeds will be about 45 mph. However, with heavy traffic in both directions it is desirable to construct use of a separate busway.

Ludwick (1975) looked at the benefits of bus priority in Washington, D.C. A model was used to simulate traffic data and look at travel times. Findings were that unconditional preemption bus priority system can provide substantial benefits to buses in an environment representative of many cities. Also, successful application of the technique requires more than just modifications to traffic signal hardware; relocation of bus stops and bus routes may also be necessary. In some instances, substantial delays to cross-street

traffic occur. Urban planners need to determine the acceptable trade-off between overall passenger movement and inconvenience to auto passengers.

Enforcement becomes an important issue when buses use separate lanes or they use car pool lanes as expressways. The lanes were designed to speed the flow of the movement of people, giving special priority to buses or vehicles with high occupancies. Individuals may wish to violate the rules of separate lanes but this defeats the purpose of the lane. Special lanes can be controversial since motorists may believe the special treatment given to high occupancy vehicles is slowing down their commute time. The enforcement of busways and bus and car-pool lane restrictions was studied by Miller and Deuser (1976). The authors included several cities in their study, including locations in Seattle, Washington; Greenbrae, California; New Jersey; Miami, Florida; Washington, D.C.; Boston, Massachusetts; and San Juan, P.R. A survey of public transit agencies involved in busways and bus and car-pool lane systems was conducted through the auspice of the American Public Transit Association (APTA). The author identified that the sample of respondents was not fully inclusive of the entire spectrum of preferential treatment systems in operation but felt the information would be useful for preliminary study. Findings revealed that 1) exclusive busways and physically separated bus and car-pool lanes are successful without expending special efforts on enforcement; 2) exclusive bus and bus and car-pool lanes that do not have the advantage of some form of physical separation have had significantly more enforcement problems; 3) preferential treatment projects requiring turning restrictions on at-grade arterial streets are difficult to enforce. Violators of these restrictions increase the possibility of increased accident rates; and 4) for that time, only conventional normal patrol-enforcement techniques had been applied to enforcement programs for preferential treatment projects.

In 1976, Schneider and Clark wrote a paper that evaluated an experimental approach for designing a bus rapid transit system. Five groups of students were given the assignment to design a BRT system to serve the University of Washington, and to meet desired levels of performance within a series of constraints. The Urban Transit Analysis System (UTRANS) was used. All evaluations were based on the values of 23 performance measures including 10 benefits measurements and 13 cost measurements. The conclusion of the author was that a group of inexperienced persons can by using UTRANS design a complex and high performance bus system in about 10 weeks. The limitation of this study was this was a simulation and not an actual implementation.

## **2.4. PRESENT BRT STATUS**

The revived interest has spawned because of the Federal Transit Administration's limited ability to fund every New Start rail project that is being conceived, planned, or designed. FTA views BRT as a way to improve public transportation systems. The late 1990s began to bring Bus Rapid Transit to the forefront again in the United States. The FTA introduced the *Bus Rapid Transit Demonstration Program*.

The objectives of the *Bus Rapid Transit Demonstration Program* serve to advance the FTA Research and Technology goals to:

1. provide better bus service for existing riders,
2. attract more riders to improved service,
3. improve the efficiency of operations for transit providers,
4. demonstrate that BRT could be an effective lower cost alternative to expensive new rail transit,
5. validate that BRT and compact, pedestrian-oriented land use are mutually supportive,

6. change the perception of bus transit by the transit industry, local officials and the public, and leverage BRT to develop and foster the deployment of innovative technological improvements into transit revenue service (Thomas and Diaz 2001, p. 2).

As a result of TEA-21, FTA selected 10 BRT demonstration projects for funding. The majority of these projects are receiving funding through the New Starts Program. The number of projects in the New Starts pipeline is staggering (Thomas and Diaz 2001):

- Planning – 111 projects
- Preliminary Engineering – 48 projects
- Final Design – 23 projects
- Full Funding Grant Agreement – 33 projects.

Many of these projects will receive funding through the Section 5309 New Starts Program among other programs. Section 5309 New Starts Program has very stringent criteria the demonstration sites must meet before receiving funding. The FTA developed a guidance document containing the application and reporting procedures for Section 5309 New Starts Criteria. The document contains minor changes from the July 1999 document. It provides background on the new starts criteria and rating process. The report is detailed in that it explains what information transit systems must submit to be considered for funding under the *New Starts* program.

In 1998, the Federal Transit Administration initiated the BRT Demonstration Program to extend over the life of the Transportation Equity Act of the 21<sup>st</sup> century (TEA-21). The FTA released a Request for Proposals for BRT demonstration projects in the U.S. The demonstration sites are required to conduct an environmental assessment (EA) to identify potential environmental effects associated with BRT project construction and operation, and to provide agencies and the public the opportunity to review and comment on the potential effects of the proposed project (Greater Cleveland Regional Transit Authority, p. 1-1, 2000). Seventeen managers of transit projects submitted proposals and 10 were selected as official Demonstration projects. However, all 17 sites were invited to participate in the BRT Consortium. The systems that are operational include: South Miami-Dade, Florida; City Express! Honolulu, Hawaii; Los Angeles, California; and Pittsburgh, Pennsylvania. Many of the other systems are in various phases of their planning process. All systems are listed below and identified on Figure 1.



**Figure 1. U.S. BRT Demonstrations Sites and Consortium Members**

Source: <http://brt.volpe.dot.gov/images/usmap3.gif>

Demonstration BRT sites in the U.S. (Receiving FTA Funding), 2002

- 1) Silver Line, Massachusetts Bay Transportation Authority
- 2) Independence Corridor BRT, City of Charlotte DOT
- 3) Euclid Corridor Improvement Program, Greater Cleveland Regional Transit Authority
- 4) Dulles Corridor BRT, Virginia Department of Rail & Public Transportation
- 5) Pilot East-West Corridor BRT, Lane Transit District
- 6) Hartford-New Britain Busway, Connecticut DOT
- 7) City Express!, City and County of Honolulu
- 8) South Miami-Dade Busway
- 9) The Rio Hondo Connector Bus Rapid Transit, Puerto Rico Highway and Transportation Authority
- 10) Line 22 Rapid Transit Corridor, Santa Clara Valley Transportation Authority

Other BRT Sites (Consortium members)

- 11) Albany, New York
- 11) Chicago, Illinois
- 13) Los Angeles, California
- 14) Louisville, Kentucky
- 15) Montgomery County, Maryland
- 16) Alameda & Contra Costa, California, and
- 17) Pittsburgh, Pennsylvania



BRT continues to gain in popularity and several other cities are introducing systems into their community.

## 3.0 POLITICAL FRAMEWORKS & BRT

There is little existing literature on the political feasibility of BRT. However, with the growing interest in implementing BRT, it is important to look at the political aspects of this topic. This chapter first identifies the definition of political feasibility used for the study, second, considers the different levels of political feasibility of BRT and finally looks more closely at the local institutional barriers of BRT identified by Miller and Buckley (2000).

If it is true that politics is the “art of the possible,” then could it be true that political feasibility helps “avoid impossibilities?” In most any field of study or endeavor, it is important to know what is possible under a given set of circumstances, as well as what is not possible (Majone 1975). Political feasibility assessment explores the possibility of whether an idea (policy, program, project) can be approved and carried out, describing the chances of “getting permission” to launch that idea and assessing what cooperation might be expected (Waterfall 1982, p.11 as in Halachmi 1979, p. 293).

When searching the literature on the political aspects of BRT, it was evident this topic has not been largely examined. However, when searching the literature for political feasibility relating to transportation, congestion pricing was one of the topics identified that has considered political feasibility. Congestion is an issue that occurs at the local level. In the book *Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion (1994)*, the author indicates that congestion pricing is affected by two types of issues: technical ones and political ones. The author emphasizes that feasibility requires having an institutional mechanism to administer the program. To implement BRT, several institutions will have to work together. Furthermore, the author maintains that political feasibility is much more complex (p. 58). He states that political feasibility is a combination of issues of which the most important is public acceptance of direct payment for road use since it is viewed as a free good. Public acceptance of BRT is also an important issue. The question of implementing BRT does not mirror congestion pricing, although many view BRT as a method to help fight congestion. A survey of urban planners in Atlanta conducted in 1988 revealed they believed that one of the goals of rapid transit was combating traffic congestion (Lewis and Williams 1999, p. 11).

### 3.1. Literature Definitions of Political Feasibility

Political feasibility has been defined or addressed in a number of ways. Much of the literature addresses “probabilities,” “constraints and opportunities,” and “political prices to be paid.” One approach was described by Dror (1969) and related to three interdependent ways to relate political feasibility.

#### 3.1.1 Probabilities

The literature shows that one definition of political feasibility is judgments about the probability of success within a given time. That “probability (or range of probabilities) that within a given time, defined policy alternatives will receive sufficient political push and support to be approved and implemented.” (Yehezkel Dror 1971, p.59-60). However, judgments may be made at various points in the policy process. However, uncertainty looms in the political process because of the complex and unpredictable human behavior patterns and uncertain future events. These factors make it difficult to express objective probabilities. Furthermore, because it is difficult to specify political variables, the speculation of future

events is subject to error. As Meltsner (1972, p. 864) said, “political prediction and error are bedfellows.” When plans or initial phases of policies move from conceptual stages to actual implementation there could be endless numbers of unpredicted variations that are created and thus the potential for error also increases.

### **Constraints and Opportunities**

Constraints and opportunities are another aspect of political feasibility occurring in the literature (Schultze 1968, Robert Behn, 1981, and Giandomenico Majone 1975). Schultze (1968) thought that pointing out the probability of success is not sufficient because the probabilities are really based on the strategies used to enact the policy. Considering the constraints and opportunities of success helps to develop an understanding of the bases of support and resistance that must be addressed for success of a proposal. May (1986) identified a notable case of legislative strategy used by Senator Pete Domenici and his staff to secure passage in 1978 of waterway user fee legislation.<sup>1</sup> The strategy included identifying potential legislative obstacles including committees that may not approve of the legislation as well as essential votes. Domenici redefined the content of the bill to overcome the obstacles. However, complete and accurate knowledge of political constraints may be difficult because complete knowledge is impossible. However, by recognizing that perfect predictability does not exist, it helps to reduce the potential number of surprises that can influence a policy decision.

### **Political Prices to be Paid**

Ralph Huitt (1968, p.264) thought of political feasibility as a “political price to be paid for a course of action.” Similar to financial costs, political costs revolve around prices and opportunity costs. Whether a policy is enacted or not, there are opportunity costs of not including other issues potentially more profitable. Even if the proposal seems to have a promising probability of enactment, the political costs may be large. Paul Light found presidents and their staffs “openly subscribe to a theory of legislative expense; they believe that programs have specified political and economic price tags.” (Light, p.110).

### **Dror’s Concept of Political Feasibility**

Dror (1968, 1971) defined political feasibility as consisting of three interdependent ways (1) as relating to an actor; (2) as relating to a policy alternative; and (3) as relating to a policy area. First, from the view of the actor(s) (which may include individuals, groups, organizations, etc.), political feasibility refers to the space in which the actor is able to affect reality (within a certain probability). It is closely affiliated with “influence” and “power.” The term “political leverage” was used to refer to the actor’s ability to influence policies and their implementation. Second, political feasibility defined relative to policy-alternative relates to the probability or ranges of probabilities that within a specific time frame the policy alternative will receive political push and support to be approved and implemented. Third, political feasibility relating to policy area refers to the range within which alternatives are politically feasibility. Dror also called this range of alternatives the “political feasibility domain.”

There are logical and empirical relationships among these three definitions. Logically, for a policy alternative (second definition) to be politically feasibility, it must be within the political feasibility domain of the relevant policy area (third definition). Empirically, the shape and dynamics of a political

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<sup>1</sup>Chronicled in T.R. Reid, *Congressional Odyssey: The Saga of a Senate Bill* (San Francisco: W.H. Freeman, 1980).

feasibility domain are determined by the political leverages of the actors in respect to the involved policy area (Dror 1969).

### **3.2. Political Feasibility Analytic Frameworks Identified**

Scholarly attention was paid to recognizing the usefulness of policy analysis in the late 1970s and early 1980s (Weiss, 1977 and Webber, 1983) however, a framework to assess the political feasibility of policy proposals has not been achieved by political scientists (Webber 1986). A systematic approach to examining political feasibility was missing. According to Webber (1986), “even political science-trained policy analysts tend to be more capable of systematically analyzing technical and economic feasibility than they are at assessing political factors.” Today, the literature still lacks a systematic way to analyze political feasibility.

The literature revealed a few works that tried to put political feasibility in an analytic framework. These include a six-point framework and a typology. The six-point framework for explaining the policy process, also known as a “policy cycle” as described by (Vig and Kraft, 1984 p. 6) contains the components:

- agenda-setting - identification and definition of problems and advocacy of action,
- policy formulation - specification of goals and choice of means for achieving them,
- policy legitimation - mobilization of support and enactment,
- policy implementation - mobilization of resources and application to goal achievement,
- policy evaluation - measurement of results and redefinition of goals or agenda, and
- policy revision or termination

The actors and events involved in each of these stages of the “policy cycle” should be examined and the probability of the resolution should be anticipated as it works through the process (Webber 1986).

When assessing political feasibility, Meltsner, (1972) identified two alternative approaches to consider when working through policy analysis. One “is to supply an answer based on quantitative and economic reasoning and then modify it to reflect political consideration.” It is important to note that economic analysis is useful to evaluate economic costs and benefits especially when they can be used to eliminate inefficient programs. However, they can be difficult to use for making political decisions, because economic rationality and political rationality are often at odds (Diesing 1962; Wildavsky 1979; Behn 1981, p. 201.) The other approach, which is more difficult “is to introduce politics into at each stage of the analysis and identify the political constraints at each stage of the policy cycle” (Meltsner (1972).

A political feasibility typology was designed by Waterfall (1982). She attempted to demonstrate the importance and utility of political feasibility assessment as an analytical and decision-making tool for regional land use planning. The typology included the three main categories (Issues, Actors, and Arenas) and several subcategories. Subcategories were developed under each heading to organize the questions addressed regarding political feasibility. Of the typology, 1) Issues relate to problem-specific conflicts between two or more groups; 2) Actors are the individuals, groups, and organizations involved; and 3) Arenas are the policy issue area or a cluster of related issues.

First, the subcategories of Issues include its History (what happened to issue over time), Dimensions (issue changes and dimension reflects point in time and the author addresses sub-sub categories for this area), and Decision Points (each decision point is a potential constraint where actors come together and state their preferences and conflict can ensue). See Table 3.2. Identifying BRT as the issue, it is possible that communities have a history of looking at alternative transportation options to meet their needs with BRT or light rail being two alternatives. Changes in community attributes such as population, travel

patterns, and funding availability play a key role decisions for the community. Communities with increased congestion will look at ways to reduce the congestion and public transportation is one of the methods that may be used. Some communities have a history of looking at implementing light rail systems, but the community as a whole may not support that option. Some communities may explore issues such as the option of light rail and re-explore the option for many years. Sometimes the option will finally be accepted and implemented such as light rail in Minneapolis, Minnesota, which has been discussed for nearly 20 years. Other times, the discussion and efforts to implement light rail may continue for years and not come to fruition (Gomez-Ibanez et al, 1991.).

Second, the subcategories of Actors are the Benefactors and Beneficiaries that revolve around the costs and benefits or the “winners” and “losers.” The strategy of the benefactor is to provide as many groups as possible with benefits. Value Structure is another subgroup for Actors. Actors’ ideology, values, beliefs, and attitudes determine their perception, interpretation, and evaluation of reality and how they interact with that reality. Actors share an interest that can lead to their making certain claims on the rest of society. Resources are another subcategory of Actors. Resources help actors achieve access to the decision-making process and allow them to be more influential. The resources can include money, power (physical and symbolic), political and administrative skills and expertise. This is reinforced by work done by May (1986). He stated, “The real work of estimating political feasibility comes in identifying relevant interest groups and in making judgments about issue position, power, and salience for the various groups.” There is no agreement as to what composes the public interest in a pluralistic society (Ukeles 1977, p. 276). Furthermore, our decentralized political system multiplies the actors whose judgments of feasibility significantly affect a policy decision (Huitt p. 264). However, multiplying the number of actors or stakeholders in decisions complicates matters and often results in resolutions or policies taking much longer to resolve. For example, Gomez-Ibanez, et al (1991) conducted three case studies for the prospects for private rail transit. The case study cities included, Boston, Washington, D.C., and Orlando. The results indicated the economic and political dynamics that make rail transit an unpromising candidate for privatization with part of the reasoning being the multiple number of actors involved.

There are several actors involved with implementing BRT within a community. Some of these actors include the local officials, the transit agency, businesses, and residents. Some of the actors may see themselves as “winners” while others may view themselves as “losers.” For example, if BRT helps reduce congestion in the community and individuals spend less time in traffic, they would view themselves as “winners.” On the other hand, if a business must give up parking spaces in front of their business to accommodate a new bus lane, they may view themselves as “losers.” However, they may not be “losers” if the new bus lane brings more riders by their business and may actually increase the business patronage. Each of the actors within the community would have different resource base. Some businesses that may oppose BRT could band together and oppose the implementation while the residents may embrace the added transportation option. Yet, the residents’ resource base would be much more limited unless they form a coalition to support the new system. This of course is just an example. There is likely a mix of each type of actor opposing and supporting the implementation of BRT, while there may be some actors that are indifferent.

Third, the subcategories of Arenas include the Legal Authorities, which are the fixed features of the arena and include: public orders or decisions that are formal, binding, constitutions, statutes, court rules of practice, administrative regulations, treaties, interstate compacts, executive orders, judicial decisions at all levels, local laws and ordinances, attorney generals opinions, and other departmental opinions that are part of legal authorities. Another subgroup includes Informal Rules. Each arena has its own informal rules that affect choice by reducing alternatives and limiting conflict. Waterfall (1982) applied her typology to the “Givahoot National Forest” and addressed each of the categories and subcategories. Quantitative results were minimal with the exception of some costs being reported. The author did explain that using

the scenario/typology as a framework to address political feasibility is only representative for a specific point in time. Political assessment should be addressed at each stage of analysis because constraints do not necessarily behave linearly but rather may increase, decrease, and even temporarily disappear overtime (as addressed by Dror 1969, p. 283).

The arenas that would be involved in the implementation of BRT within a community could be numerous. For example, the use of railroad right-of-way or the removal of public parking may become community issues needing legal authority to intervene.

Assessing political feasibility is an ongoing process. It is important to note that the relationship between time and political feasibility is not linear. Furthermore, it is not fixed in a specific direction, nor is it continuous. It may increase for a larger time span or it may decrease (Anderson 1975). Waterfall's (1982) work provides a checklist for the factors that affect political feasibility so they can be identified and addressed and re-addressed when necessary.

Several aspects are important, but one in particular can be attributed to Huitt as he identified that the feasibility in politics depends upon the goals under consideration (p. 264). The feasibility of BRT is in many ways dependent upon the goals of the city considering its implementation. For example, when considering congestion within a city, the goals among the officials, planners, and engineers may differ. One may look at the number of people they move, while the other group focuses on the number of vehicles they move. Each of these groups may have different goals and interests and need to reach an agreement.

The local level is the primary concern of this study. Some of the local stakeholders include: city council, transit district/operating agency, traffic engineering, planners, general public, business community, environmental groups, advocates such as for disadvantaged, suppliers/consulting firms. For simplicity, the local groups will be categorized into transit agency, local officials, and residents.

Each actor may have several areas of concern regarding BRT. Likewise, some of the issues may overlap with each of the actors. Miller and Buckley (2000) conducted a study to identify the institutional barriers to BRT. The institutional barriers contain several issues that need to be addressed by the various groups of actors identified for this study. The barriers identified contain a good comprehensive list of factors that need to be addressed before a BRT system could be deemed politically feasibility.

They identified nine categories with which institutional barriers exist. Even though there is a category that is identified as "political" several of the other categories contain political types of elements that would need to be addressed.

- Intergovernmental/interorganizational
- intra-agency
- political
- public relations and marketing
- funding and finance
- labor
- safety and liability
- planning and land use
- physical environment

Each of these categories contains several issues identified by the group working at PATH on this project. Several of the issues within each category are of concern to the transit agencies, local officials, as well as

the residents of the community considering implementing BRT. Table 3.3 contains the categories and issues.

**Table 3.3.** California PATH Study: Institutional Barriers, 2000

| <b>A. intergovernmental/interorganizational</b>   |  |
|---|--|
|   | integration of multiple priorities, objectives, and agendas  |
|   | impacts of BRT on roadway operations   |
|   | Streets/ highway departments “relinquishing” control of their infrastructure                                     |
|   | agreement on performance measures  |
|   | maintenance responsibilities for shared infrastructure and hardware/software                                     |
|   | responsibility for enforcement on bus lanes/busways  |
|   | institutional fears of new technologies  |
|   | coordination on selection and implementation of technologies   |
|   | coordinating other transit agencies’ services and BRT operations   |
| <b>B. Intra-agency (within transit systems) -</b> |  |
|   | concerns or perceptions that BRT is given special preference over other transit services                         |
|   | defining and agreeing on new roles, responsibilities, and organizational structures to support BRT               |
|   | creation of design and operational guidelines for BRT  |
|   | determining an appropriate fare structure and medium   |
|   | internal coordination on selection of technology   |
|   | coordinating schedules of other transit routes with BRT operations   |
|   | Insufficient understanding of the ‘state of the art’ of technologies and how they can be used in BRT operations. |
| <b>C. Political</b>                               |  |
|   | concerns of BRT being a top down solution  |
|   | perceived or actual competition of BRT with rail transit   |
|   | lack of domestic BRT success stories   |
|   | lack of empirical evidence of BRT’s operational effectiveness  |
|   | finding political champions to support BRT   |
|   | Concerns over the distribution of the costs and benefits of BRT  |
|   | legal issues associated with service changes   |
|   | new vehicle procurement  |

|  |   |
|--|---|
| <b>D. Public Relations and Marketing</b> |   |
|  | educating the public on BRT, and managing perceptions and expectations  |
|  | concerns over transit agency's existing performance and reputation  |
|  | concerns over effects of BRT on existing roadway operations   |
|  | educating pedestrians and motorists on interacting with BRT   |
|  | educating users on changes in and uses of multiple fare structures  |
| <b>E. Funding and Finance</b>            |   |
|  | concerns over long-term funding commitments to BRT at the state and federal levels                                    |
|  | concerns about BRT redirecting funds away from existing service or other routes                                       |
|  | lack of understanding of funding mechanisms available for BRT   |
|  | agency reluctance to expand services due to current fiscal constraints  |
|  | ability to use existing buses or need for new fleet   |
|  | capital costs of BRT  |
|  | cost of operating and maintaining (O&M) new technologies and infrastructure   |
|  | cost of additional staff and/or training to support BRT   |
|  | cost of additional facilities to support BRT  |
|  | cost of and responsibility for enforcement e.g., proof of payment   |
| <b>F. Labor</b>                          |   |
|  | lack of support from transit agency staff   |
|  | changing role of drivers  |
|  | use of automated vehicle location (AVL) systems for monitoring schedule adherence                                     |
|  | different responsibilities between BRT and non-BRT routes   |
| <b>G. Safety and Liability</b>           |   |
|  | insurance industry-initiated changes in assignment of risk and responsibility for bus transport                       |
|  | potential changes in liability associated with technological and/or operational malfunctions of BRT systems           |
|  | safety issues arising from changing interaction of pedestrians and motorists with new technologies and /or strategies |
|  | Safety concerns of residents along BRT corridors  |

|   |  |
|---|--|
| <b>H. Planning and Land Use</b>   |  |
|   | integrating BRT projects into the metropolitan planning process                    |
|   | lack of empirical evidence on the effects of BRT on land use                       |
|   | coordinating BRT project with local planning agencies' land use                    |
|   | gaining community support for transit oriented development                         |
|   | concerns of potential developers over BRT's lack of permanence as compared to rail |
| <b>G. Physical Environment</b>  |  |
|   | availability and acquisition of right-of-way or physical space                     |
|   | reaching agreement or consensus on bus stop/station area enhancements              |
| Source: Miller and Buckley. <i>Institutional Aspects of Bus Rapid transit - A Macroscopic Examination</i> . California PATH Working Paper UCB-ITS-PWP-2000-7. 2000. |  |

Miller and Buckley (2001) continued their work on institutional barriers and surveyed the BRT Consortium members and Canadian members to identify their perceptions on the institutional barriers identified. The survey listed 57 issues that were grouped into their nine categories that were identified in their earlier work (2000). Survey participants were asked to rate each issue on a scale of 1 (lowest) to 5 (highest) in terms of the issue's importance and difficulty in resolving it. The respondents were to reply in terms of their own BRT system. The surveys were categorized into groups including: Transit Properties, Highway/Streets Departments, and Planning Agencies. Likewise, data was stratified according to systems that had "mixed traffic BRT" and "exclusive facilities." The mixed traffic BRT and exclusive facilities are important characteristics of BRT systems. The classification may be important to help characterize the political feasibility of BRT. Implementing a mixed traffic BRT system or an exclusive facility may be one of the political factors considered in this study, so the Miller and Buckley findings are important results to consider.

Results were given for overall, and for case studies on three California BRT systems. After narrowing the results, Table 3.4 contains the listed issues that were found to be the most important and most difficult to resolve unique to each operational setting. The findings seem quite intuitive.



| <b>Table 3.4. BRT Consortium Findings for Most Important and Most Difficult Issues Unique to each Operational Setting/Organizational Type Combinations.</b> |  |   |
|---|--|---|
|   | <b>Mixed Traffic</b>   | <b>Exclusive Facilities</b>   |
| <b>Transit Property</b>   | <ul style="list-style-type: none"> <li>-Creation of design and operational guidelines for BRT</li> <li>-Cost of and responsibility for enforcement</li> </ul>  | <ul style="list-style-type: none"> <li>--Lack of domestic BRT success stories</li> <li>-New vehicle procurement</li> <li>-Lack of understanding of funding mechanisms available for BRT</li> <li>-Ability to use existing buses or need for new fleet</li> <li>-Liability</li> </ul>  |
| <b>Highway/ Streets Departments</b>   | <ul style="list-style-type: none"> <li>-Concerns over transit agency's existing performance and reputation</li> <li>-Concerns of potential developers over BRT's lack of permanence as compared to rail</li> </ul>   | <ul style="list-style-type: none"> <li>-Capital costs of BRT</li> <li>-Cost of operating and maintaining new technologies and infrastructure</li> <li>-Cost of additional staff and/or training to support BRT</li> <li>-Cost of and responsibility for enforcement</li> <li>-Safety concerns of residents along BRT corridors</li> </ul> |
| <b>Planning Agencies</b>  | <ul style="list-style-type: none"> <li>-Concerns over long term level of interest, potential for waning political support</li> <li>-Educating users on changes in and uses of multiple fare structures</li> <li>-Safety concerns of residents along BRT corridors</li> </ul> | <ul style="list-style-type: none"> <li>-Lack of empirical evidence of BRT's operational effectiveness</li> <li>-Coordinating BRT project with local planning agencies' land use plans</li> </ul>  |
| Source: Mark Miller and Stephen Buckley. <i>Institutional Aspects of Bus Rapid Transit Operation</i> . California PATH, 2001, forthcoming                   |  |   |

As there are many institutional issues, many decisions need to be made and accurate information is crucial to all decisions made. Alain Enthoven stated it well:

Ultimately all policies are made...on the basis of judgments. There is no other way and there never will be. The question is whether these judgments have to be made in the fog of inadequate and inaccurate data, unclear and undefined issues, and a welter of conflicting personal opinions, or whether they can be made on the basis of adequate, reliable information, relevant experience, and clearly drawn issues ---

When implementing or determining if a BRT system should be adopted in a community, it is imperative that the community use accurate data and clearly define its issues. Decisions to implement BRT are based upon judgment, but feasibility of the system is paramount before the judgment of implementation can be made. There are several categories of feasibility to consider including technological, economical, environmental, and political. Although each category is important, political feasibility will be the focus in this study.

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Reference Tables of BRT Studies

| Study                              | Study Area          | Study Objective   | Source of Data                                | Method of Analysis | Analysis Unit | Independent Variable  | Dependent variable                                     | Findings  | Limitations   |
|------------------------------------|---------------------|---|---|--------------------|---------------|---|--|---|---|
| Levinson & Sanders (1974)          | Contra lanes        | Determine minimum number of buses needed to warrant a bus lane.                                 | Estimates                                     | Model              | Buses, speed  | Estimates of the change in automobile and bus travel times due to contraflow bus lane, changes in operating speeds and travel times | Number of buses  | Traffic volumes need to warrant 40,60, 80, 100, and 150 buses in a reserved lane. , a greater number of buses are required to warrant a contraflow bus lane. Nonlinear decrease in speed as vehicle demand increases and approaches or exceeds the facility's capacity..<br>*With a flow less than 3,600 vehicles per hour in the heavy direction, buses can continue to operate normally because their speeds will about 45 mph.   |   |
| Olsen & Smith (1974)               | Clearwater, Florida | To provide psychological data as inputs to analysis and design of public transportation systems | 145 users and nonusers of the bus system.     | Survey, comparison | Personal      | Injury, health risks, annoyances, and long-time pressures (e.g., delays)  | Younger riders, elderly riders, healthy, less healthy, | *Nonusers expressed greater levels of concern for injury risk, health risk, annoyance, and long-time pressure.<br>*nonusers reflected their bias against bus riding in areas of long waits, unexpected delays, unpredictable service, and general inconvenience, however their concern about health and injury risks as compared with users is not so easily explained.<br>*data showing effect of age on transportation concerns are important health and injury concerns were directly related to age. Elderly also concerned they could not move fast enough to match situation requirement..<br>*data show people respond psychologically quite differently to various transp. Equipment and system characteristics according to membership in relevant demographic groups. | *budget and time constraints were responsible for the limited sample size; the Clearwater bus service was conceived as a demonstration program which could have led to findings atypical of bus service in general. |
| Meier, Vederoff, and Porter (1974) | Seattle Area        | Assess implementation of regional rapid transit   | PSGC data Puget Sound Governmental Conference | Comparison         | Cost          | Number of riders and costs  | Estimate number of riders based on other system        | Node-oriented bus transit system is potentially an economically feasible method for Puget Sound.  | Operating costs for the system are difficult to estimate because of lack of operating data for a comparable system.   |
| Ludwick                            | 18 <sup>th</sup> &  | Look at   | Simulated                                     | Model              | Travel time   | Headways  | Mean travel time                                       | *simulation results indicated   | Future investigations   |

| Study                      | Study Area  | Study Objective  | Source of Data   | Method of Analysis   | Analysis Unit            | Independent Variable      | Dependent variable | Findings   | Limitations  |
|----------------------------|---|--|--|--|--------------------------|---------------------------|--------------------|--|--|
| (1975)                     | 19 <sup>th</sup> St. Washin gton, D.C.,               | benefits of bus priority * mean travel times   | traffic data   |  |                          | Simulated traffic         |                    | unconditional preemption bus priority system can provide substantial benefits to buses in an environment representative of many cities. *Successful application of the technique requires more than just modifications to traffic signal hardware; relocation of bus stops and bus routes may also be necessary. In some applications, BPS will have little effect on other vehicles or it may cause substantial delay to cross-street traffic. Urban planner must determine the acceptable trade-off between overall passenger movement and inconvenience to auto passengers. | needed in at least three areas: relation between the design variables and the various performance measures must be defined so the designer can use them to make decisions as to how to modify a particular design so that it will have better performance. Second, the relations between the various performance measures should be defined so that the designer can know which ones are highly correlated and which are relatively independent. Third, search for unconventional designs that have high performance ratings should receive more attention |
| Crain (1975)               | Los Angels, CA<br>NOTE: first BRT system in U.S. 1973 | Determine if buses put into rapid transit form can be found attractive by the riding public. | Ridership on busway and traffic counts on the parallel highway. Also HH Survey, on-board survey. | Survey, central market analysis, cost analysis,, modal split analysis    | Neighborhood             | Busway                    | Public acceptance  | 75 % of general public were (+) of the busway about 20% were (-). Ridership rose– table showed Jan 1973 = 1,200 during peak and June 1974 = 7,500 during peak. <b>Survey identified reasons for switching p. 26</b> people indicating they won't use transit is because they need their car during day.  | Short time span for evaluation??? How is it now???   |
| Schneider and Clark (1976) | Univer sity of Washin gton, Seattle                   | Evaluate an experimenta l approach for designing a bus rapid transit                         | Student design projects based on 23 objectives   | Students use UTRANS (interactive graphics package)– disutility equations | 23 performanc e measures | Several cost and benefits | Utility            | *visual and quantitative characteristics of recommended design: mostly east-west lines,<br>*comparison of performance : very similar, but teams were constrained by same number of bus stops and teams were quick to imitate each other's  |  |



| Study                    | Study Area   | Study Objective                    | Source of Data                  | Method of Analysis | Analysis Unit                              | Independent Variable                         | Dependent variable | Findings   | Limitations |
|--------------------------|--|------------------------------------|---------------------------------|--------------------|--|--|--------------------|--|-------------|
|                          |  | system                             |                                 |                    |  |  |                    | <p>successes.</p> <ul style="list-style-type: none"> <li>• 5 measures were above ideal standards in all seven final designs they were: average waiting time, average parking lot fee, percentage within 5-min drive of lot, percentage of fuel saved, and lot capital cost. .</li> <li>• *13 measures were above acceptable but did not exceed ideal: impact of parking lot, bus-operations profit, avg. riding time in bus, avg. access time walking to stop, avg bus fare, probability of obtaining a seat, percentage of bus capacity used, percentage within 5 min walk to bus stop, percent using walk and ride mode, walk and ride equity, percent using park and ride mode, park and ride equity, and bus capital cost.</li> <li>• A group of inexperienced persons can, by using UTRANS design a complex and high performance bus system in about 10 weeks.</li> </ul> |             |
| Miller and Deuser (1976) | Several locations: Seattle, CA, NJ, FL, D.C., Boston, San Juan, P.R. | Bus and carpool enforcement issues | Questionnaire sent through APTA | Tally results      | State and local jurisdictions and each HOV | Identified enforcement planning for projects | Enforcement        | <p>*exclusive busways and physically separated bus and car-pool lanes are successful w/o expending special efforts on enforcement</p> <p>*exclusive bus and bus and car-pool lanes that do not have the advantage of some form of physical separation have had significantly more enforcement problems specific examples include; Northwest seventh ave. US-1 and I-95 bus and carpool in Miami and curb bus lanes in Washington, D.C.</p> <p>*preferential treatment projects requiring turning restrictions on at-grade arterial streets are difficult to enforce. Violators of these restrictions</p>   |             |

| Study                                     | Study Area                     | Study Objective  | Source of Data   | Method of Analysis | Analysis Unit                                    | Independent Variable | Dependent variable | Findings   | Limitations                               |
|---|--------------------------------|--|--|--------------------|--|----------------------|--------------------|--|---|
|   |                                |  |  |                    |  |                      |                    | <p>expose the project o the possibility of increased accident rates</p> <p>*to date, only conventional normal-patrol enforcement techniques have been applied to enforcement programs for preferential treatment projects.</p>   |   |
| Mark, Ho, and Papacostas (1976)           | Honolulu                       | To provide the City and county of Honolulu with info on the morning ridership boarding at each bus stop in Hawaii Kai, the number of passengers disembarking at each destination stop, and general ridership profiles. | On-board survey 4570 workers in which 4222 were valid. And door-to-door survey         | Survey             | Ridership, personal                              |                      |                    | <p>*express bus patronage was significantly higher than that of the prior bus service.</p> <p>*significant portion of morning riders did not use the service for return trip.</p> <p>*proportion of male and female riders was about even and predominant occupations were professional and technical.</p> <p>*about half of all riders came from homes that owned two cars.</p> <p>*about 60 percent of CBD riders and 40 percent of riders on university route were former auto drivers.</p> <p>*Increase in patronage over the survey period were in part due to gasoline shortages. The group most affected by gasoline shortages were students.</p> | Controlling for gasoline shortage.        |
| Spencer and Andong (1996)                 | Beijing                        | Compare light rail to busway   | Trip matrices and bus service supplied by BPTC, traffic speeds and volumes 1993 & 1994 | BCA                | Time savings and reduced vehicle operating costs |                      |                    | Busway is capable of carrying passengers forecast for 2000   | No account taken of impact on road space. |
| Parsons Brinckerhoff Quade & Douglad, Inc | Various, chapter on Curitiba & | General info   | Various  | Case studies       | Overview of system                               |                      |                    | Reviewed the process and the successes of several case studies. Curitiba plan and success.   |   |

| Study   | Study Area             | Study Objective  | Source of Data   | Method of Analysis          | Analysis Unit                   | Independent Variable | Dependent variable | Findings  | Limitations  |
|---|------------------------|--|--|-----------------------------|---------------------------------|----------------------|--------------------|---|--|
|   | Ottawa                 |  |  |                             |                                 |                      |                    |   |  |
| Gardner L. (1998)                               | Eugene, OR             | Describe benefits of BRT to medium-sized city  |  | Descriptive                 | Pros and cons of pilot corridor |                      |                    | Overview of what they are doing and the benefits.   | Lacks quantitative analysis  |
| Kain (1999)                                     | Various                | Look at urban transportation problem – section on shared bus-HOV vs. Exclusive busways | Various  | Descriptive                 |                                 |                      |                    | Look at costs of rail and busways   | Costs may not be represented accurately. Work by Bitzan (2000) pointed out underestimated the costs of new rail systems, overestimated the costs of existing bus systems, and overpredicted ridership on the new transit system. |
| Scott, Painter, & Casavant (1999)               | Washington State       | Measure user and non-user benefits from public transit system                          | Survey   | Contingent valuation method | Dollars per household           |                      |                    | Respondents willing to pay \$9.30 per home per month for a local transit system that fit their needs. Non-users = \$7.10/mo. When asked for comp. for giving up transit access = \$45.42  | Need update  |
| New Britain-Hartford Busway                     | New Britain & Hartford | Look at services to operate on busway. Look at service levels. Estimate time savings.  | Held public meetings.  |                             |                                 |                      |                    |   |  |
| BRT Characteristics Mitretek 20 Sept 2000 draft |                        | Vehicle characteristics and extent those characteristics are available from            | Interviews with nine transit agencies and four potential BRT vehicle | Survey/interview            |                                 |                      |                    | *Goals of BRT, shorter trip times, short wait between vehicles, accessible, distinctive, easy to use, welcoming, low emissions.<br>*core BRT characteristics, potential BRT vendors, BRT vehicle design, bus design standards, BRT vehicle procurement strategies |  |

| <b>Study</b>  | <b>Study Area</b>                       | <b>Study Objective</b>                         | <b>Source of Data</b>     | <b>Method of Analysis</b>                           | <b>Analysis Unit</b> | <b>Independent Variable</b>   | <b>Dependent variable</b> | <b>Findings</b>  | <b>Limitations</b> |
|---|---|--|---------------------------|---|----------------------|---|---------------------------|--|--------------------|
|   |   | vendors.                                       | vendors                   |   |                      |   |                           |  |                    |
| Lane Transit District (2000)                        | BRT Consortium Members                  | Vehicle Survey                                 | Survey                    | Summary of responses                                | Questions            | None  |                           | Most members would be purchasing vehicles, several preferred low floor and looks like rail.  |                    |
| Miller and Buckley (2000)                           | General                                 | Identify institutional barriers/aspects to BRT | Lit review, group meeting |   | Lit                  |   |                           | Identified nine categories of institutional barriers with many issues within each. Questioned if BRT was a fad. Looked at the ITS/technology to be included in new BRT demonstrations. Reviewed international successes. |                    |
| Diaz and Schneck (2000)                             | North and South America BRT systems (8) | Looked at BRT technology applied.              |                           | Effects of types of technologies on service quality | Each BRT system      | Speed, reliability, safety and security, user-friendliness, comfort | System technology         | Identified five major elements of BRT: vehicles, guideways, control systems, fare collection system, and passenger information systems.  |                    |
| Chicago Limited stop arterial DRAFT – from TRB 2001 | Chicago limited stop study              | Look at marketing and service design, etc.     | Web and study             | Customer loyalty index                              | Customer             |   |                           |  |                    |
| Brt.volpe.dot.gov                                   | All demonstration sites                 | Info on each                                   |                           |   |                      |   |                           |  |                    |
| Environmental Assessment                            | Cleveland, & Eugene                     | Info for each                                  | Various                   |   |                      |   |                           |  |                    |

## Appendix B: Survey

### Questionnaire for Potential Commuter Service between Wahpeton-Breckenridge and Fargo-Moorhead

Clay County Rural Transit is considering implementing an “express bus” that would serve the commuters between Wahpeton-Breckenridge and Fargo-Moorhead areas. Your input is very important in determining the feasibility of offering this service. Please take a few minutes and complete the following questionnaire.

**PLEASE NOTE:**

*Table 1* illustrates vehicle costs. Traveling between Wahpeton-Breckenridge and Fargo-Moorhead equates to driving approximately 100 miles round-trip. The **total average** cost for commuting between Wahpeton-Breckenridge and Fargo-Moorhead is approximately \$1,000 per month (\$0.50/mile x 100 miles x 20 days = \$1000/month).

**Table 1 American Automobile Association Vehicle Cost Estimates**

|   | <b>Medium Car</b><br>(Cavalier LS) | <b>Large Car</b><br>(Taurus SE) | <b>SUV</b><br>(Blazer) | <b>Van</b><br>(Caravan SE) |
|---|------------------------------------|---------------------------------|------------------------|----------------------------|
| Gas & oil                                 | 6.1¢                               | 7.1¢                            | 7.9¢                   | 7.1¢                       |
| Maintenance                               | 3.9¢                               | 4.1¢                            | 4.1¢                   | 3.9¢                       |
| Tires                                     | 1.5¢                               | 1.8¢                            | 1.5¢                   | 1.6¢                       |
| <b>Operating costs/mile</b>               | <b>11.5¢</b>                       | <b>13.0¢</b>                    | <b>13.5¢</b>           | <b>12.6¢</b>               |
| Insurance                                 | \$181                              | 1075                            | \$950                  | \$873                      |
| License & registration                    | \$167                              | \$206                           | \$289                  | \$259                      |
| Depreciation                              | \$3,051                            | \$3,693                         | \$4,286                | \$3,772                    |
| Financing                                 | \$554                              | \$751                           | \$867                  | \$755                      |
| <b>Ownership cost/year</b>                | <b>\$3,953</b>                     | <b>\$5,725</b>                  | <b>\$6,392</b>         | <b>\$5,659</b>             |
| <b>Total cost for 12,500 annual miles</b> | <b>\$5,391</b>                     | <b>\$7,350</b>                  | <b>\$8,080</b>         | <b>\$7,234</b>             |
| <b>Average cost per mile</b>              | <b>\$0.43</b>                      | <b>\$0.59</b>                   | <b>\$0.65</b>          | <b>\$0.58</b>              |

SOURCE: *Your Driving Costs 2003*, American Automobile Association ([www.aaamissouri.com/news/library/drivingcost](http://www.aaamissouri.com/news/library/drivingcost)), based on data from Runzheimer International.

Considering the above comments, please fill out this brief questionnaire.

- 1). Would you ride an “express bus” that has **DIRECT** service between Wahpeton-Breckenridge and Fargo-Moorhead if the **monthly** fare was between \$100 and \$150 and the **daily** round-trip fare was between \$7 and \$10?

- |                                |  |
|--------------------------------|--|
| <input type="checkbox"/> Yes   | <input type="checkbox"/> No                    |
| <input type="checkbox"/> Maybe | <input type="checkbox"/> Need More Information |

2). If yes, how often would you ride?

- |  |   |
|--|---|
| <input type="checkbox"/> 5 days per week   | <input type="checkbox"/> 1-2 days per week          |
| <input type="checkbox"/> 3-4 days per week | <input type="checkbox"/> 1-2 times per <b>Month</b> |
| <input type="checkbox"/> 2-3 days per week | <input type="checkbox"/> Other _____                |

3). Would you travel to either Wahpeton-Breckenridge or Fargo-Moorhead for the following reasons?

- |   |                                      |
|---|--------------------------------------|
| <input type="checkbox"/> Employment     | <input type="checkbox"/> Shopping    |
| <input type="checkbox"/> Attend college | <input type="checkbox"/> Other _____ |

4). If using the express bus for employment, where is the location of your work?

- |                                      |                                      |
|--------------------------------------|--------------------------------------|
| <input type="checkbox"/> North Fargo | <input type="checkbox"/> Moorhead    |
| <input type="checkbox"/> South Fargo | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> West Fargo  |                                      |

5). If using the express bus for employment, what time do you need to be at work?

- |   |   |
|---|---|
| <input type="checkbox"/> Between 6 a.m. and 6:30 a.m. | <input type="checkbox"/> Between 7:30 a.m. and 8 a.m. |
| <input type="checkbox"/> Between 6:30 a.m. and 7 a.m. | <input type="checkbox"/> Between 8 a.m. and 8:30 a.m. |
| <input type="checkbox"/> Between 7 a.m. and 7:30 a.m. | <input type="checkbox"/> After 8:30 a.m.              |

6). What time are you typically finished with work each day?

- |   |   |
|---|---|
| <input type="checkbox"/> Between 3 p.m. and 3:30 p.m. | <input type="checkbox"/> Between 4:30 p.m. and 5 p.m. |
| <input type="checkbox"/> Between 3:30 a.m. and 4 p.m. | <input type="checkbox"/> Between 5 p.m. and 5:30 p.m. |
| <input type="checkbox"/> Between 4 p.m. and 4:30 p.m. | <input type="checkbox"/> After 5:30 p.m.              |

7). Would you be more willing to ride the express bus if there was a guaranteed ride home (taxi) in case of emergencies?

- |                                |  |
|--------------------------------|--|
| <input type="checkbox"/> Yes   | <input type="checkbox"/> No                    |
| <input type="checkbox"/> Maybe | <input type="checkbox"/> Need More Information |

8). Do you receive a transportation stipend (subsidy) from your employer?

- |                                |  |
|--------------------------------|--|
| <input type="checkbox"/> Yes   | <input type="checkbox"/> No                    |
| <input type="checkbox"/> Maybe | <input type="checkbox"/> Need More Information |

9). Are you aware that transportation subsidies provided to employees by their employers are tax deductible?

- |                                |  |
|--------------------------------|--|
| <input type="checkbox"/> Yes   | <input type="checkbox"/> No                    |
| <input type="checkbox"/> Maybe | <input type="checkbox"/> Need More Information |

10). If you are required to purchase a parking permit, what is the cost?

- |  |  |
|--|--|
| <input type="checkbox"/> Less than \$20 per month        | <input type="checkbox"/> Between \$30 and \$40 per month |
| <input type="checkbox"/> Between \$20 and \$30 per month | <input type="checkbox"/> More than \$40 per month        |

11). What time(s) of the day would you ride an express bus if it were available for reasons other than employment (you can select more than one response)?

- |   |  |
|---|--|
| <input type="checkbox"/> Between 6 a.m. and 8 a.m.  | <input type="checkbox"/> Between 2 p.m. and 4 p.m. |
| <input type="checkbox"/> Between 8 a.m. and 10 a.m. | <input type="checkbox"/> Between 4 p.m. and 6 p.m. |
| <input type="checkbox"/> Between 10 a.m. and Noon   | <input type="checkbox"/> After 6 p.m.              |
| <input type="checkbox"/> Between Noon and 2 p.m.    |  |

12). How long would you be willing to wait for a **free** transfer between the express bus and a metro area transit bus?

- |                                     |   |
|-------------------------------------|---|
| <input type="checkbox"/> 5 minutes  | <input type="checkbox"/> 20 minutes           |
| <input type="checkbox"/> 10 minutes | <input type="checkbox"/> 30 minutes           |
| <input type="checkbox"/> 15 minutes | <input type="checkbox"/> More than 30 minutes |

13). What would keep you from using this service?

- |   |  |
|---|--|
| <input type="checkbox"/> Prefer to drive myself | <input type="checkbox"/> Does not fit my flexible schedule |
| <input type="checkbox"/> Inconvenient           | <input type="checkbox"/> Work rotating schedule (nights)   |
| <input type="checkbox"/> Too costly             | <input type="checkbox"/> Other _____                       |

14). What is your age?

- |                                   |                                  |
|-----------------------------------|----------------------------------|
| <input type="checkbox"/> Under 18 | <input type="checkbox"/> 45 – 65 |
| <input type="checkbox"/> 18 – 25  | <input type="checkbox"/> Over 65 |
| <input type="checkbox"/> 25 – 45  |                                  |

15). What is your highest education level completed?

- |   |  |
|---|--|
| <input type="checkbox"/> Less than high school          | <input type="checkbox"/> Bachelor's Degree |
| <input type="checkbox"/> High School                    | <input type="checkbox"/> Graduate Degree   |
| <input type="checkbox"/> Trade/Technical/Junior College |  |

16). What is your household income level?

Below \$20,000

\$20,000 - \$30,000

\$30,000 - \$40,000

\$40,000 - \$50,000

Above \$50,000