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Women's Issues in Transportation
Research Problem Statements

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TRB TASK FORCE ON WOMEN'S ISSUES IN TRANSPORTATION (A3B56)

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Introduction

The purpose of the Task Force is to

- Stimulate gender-related research in the transportation community;
- Identify opportunities for improving safety and travel for all citizens; and
- Promote women as decision-makers in the transportation community.

The objectives of the Task Force are to

1. Identify emerging gender-related issues in transportation as they relate to safety, security, travel patterns, and career patterns and development;
2. Define research needs related to these issues; and
3. Stimulate, gather, and disseminate relevant research findings.

The desired outcomes of the work of the Task Force are to

1. Translate research findings into messages and programs that inform and improve safety and travel;
2. Close the gap between “state of the art” and “state of implementation” in transportation-related research findings; and
3. Ensure that the transportation system is responsive to the needs and issues of women.

In response to a solicitation, the Task Force received 12 research problem statements, which are presented in this Circular. After rating the statements using criteria that include the critical nature of the research, the benefits of the research, the application of the results, the impact of implementation of the results, and the risk involved in undertaking or not undertaking the research, the Task Force rated five statements as “high priority” for action. The five statements are: “Occupant Restraint Design for Women and the Elderly,” “Women Drivers’ Risk of Death in a Fatal Crash,” “Impediments to Trip-Making by Women Aged 65 or Older,” “Gender Differences in Driver Skill Development,” and “An Examination of the Career Paths of Women in Transportation.”

An additional feature of the research problem statements is listing of a “mentor.” The person listed for each statement has a particular interest in that area and can be contacted with questions or for further discussion. The 12 research problem statements are

1. Occupant Restraint Design for Women and the Elderly,
2. Women Drivers’ Risk of Death in a Fatal Crash,
3. Impediments to Trip-Making by Women Age 65 and Older,
4. Gender Differences in Driver Skill Development,
5. Examination of the Career Paths of Women in Transportation,
6. Workshop on the Feasibility of a Joint Strategy for Welfare Reforms and Advanced Vehicle Deployment,
7. Enticing Aging Baby Boom Women Back to the City,

8. Changes to the School Bus Transportation System Since 1929 and Recommendations for the Future,
9. School Bus Intelligent Information System for Collecting and Disseminating Location Information,
10. Educommuting: Bus Broadcasting System for School Buses,
11. Profiles of Courage: Effective Women's Leadership Case Studies in the Transportation Industry, and
12. Best Practices for Advancing and Expanding the Participation of Women in the Transportation Industry.

Research Problem Statements

Occupant Restraint Design for Women and the Elderly

Problem: Research evidence shows that, in a crash of specified dimensions, women are more likely to be killed than men. The reasons for this injury differential for men and women are not known, but one possibility is the effectiveness of occupant restraints for women. It is also the case that older occupants are more vulnerable to fatal injury in a given crash. Because the female-to-male ratio increases with age, issues concerning the elderly affect more women than men. Furthermore, there has been no research aimed at safe occupant restraints for transporting the frail elderly. Most frail elderly are cared for by family and transported in family vehicles. However, in the event of a sudden stop, the belt that protects the young occupant may inflict fatal injury to the frail elderly. Occupant restraints were not designed with either women or the elderly in mind. Even the relatively recent implementation of air bags is based on a standard requiring protection for an unbelted 150-pound male. There remains a need for research on more effective occupant restraints for women and the frail elderly.

Objective: The objective of the proposed research is to identify the injury-causation factors in fatalities occurring to women and the frail elderly and to design more effective restraint systems for these populations.

Key Words: Sex, gender, females, safety belts, aging.

Related Work: Not aware of any.

Urgency/Priority: Women's role in society has changed drastically. Our economy is dependent on their participation in the labor force, and consequently their health and well being is of concern to everyone. Women also account for the major changes in travel behavior in the United States over the past quarter century. Furthermore, they have disproportionately increased their involvement in fatal crashes, as compared to injury and property-damage-only crashes. The elderly are also an increasing part of the economy. Social Security changes will postpone retirement until age 67, and current deliberations are considering even higher retirement ages for future generations, so that the elderly will become a large part of the labor force. The elderly are also the fastest growing segment of the driving population, and women are an increasing proportion of them. As women and the elderly increase their presence on the highways, the importance of adequate occupant restraint systems increases. The failure to improve current systems translates into increased injury and death, as well as increased societal costs.

Cost: The cost is difficult to estimate, because the research areas have not been addressed. There is a need for crash investigations to identify mechanisms of injury, careful analysis of existing crash data, possibly compilation of additional data, conduct of detailed autopsies in relation to restraint systems and other vehicle characteristics, and extensive development of new systems and their investigations in laboratory settings

(e.g., sled testing). A reasonable start could be made on the preliminary studies for \$300,000, but much more will be needed to do everything required.

User Community: Certainly NHTSA should have some interest, as should the automotive manufacturers and some automotive suppliers. Also, the National Institute on Aging may have some interests, and possibly the Centers for Disease Control. The insurance industry may have some interest as well.

Implementation: If improved systems can be developed, or requirements for improved systems identified, the automotive industry should have some interest in incorporating the research finding into their restraint systems. Because restraint systems are an integral part of the vehicle, the implementation has to occur at that level.

Effectiveness: Effectiveness will depend upon the success of any new systems in reducing injury and death. The cost of injury is a significant part of health-care costs, and women and the elderly suffer injury disproportionately. Furthermore, the elderly require more care for the same level injury, so that injury reduction to this population results in greater savings. It is not possible at this time to estimate cost savings or societal impact, but the affected populations are growing.

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Women Drivers' Risk of Death in a Fatal Crash

Problem: Women drivers involved in fatal crashes today have a greater risk of dying in the crash than they would have had 20 years ago. Expressed relative to 1975 as the base year, the proportion of women drivers involved in fatal crashes who die in those crashes has shown a steady increase from 40 to over 45 percent. While a five-percentage point change in any year may not be cause for alarm, the data for the past 20 years show that this proportion has been gradually and consistently increasing.

Viewed another way, the risk of death to female drivers involved in fatal crashes has increased approximately 12 percent over the baseline year of 1975. This is an increase of over 2 percent each year from 1976 to 1996.

Objective: The proposed research would be designed to identify the factors that contribute to the gradual rise in women drivers' risk of death in fatal crashes. The general areas of investigation will include changes in the vehicles that women are driving, and changes in women's driving patterns and behaviors. The following research questions will be addressed, at a minimum:

- What are the differences between the vehicles that women are driving today and those women were driving 20 years ago? Do those differences contribute to increased risk to the driver?
- Have changes in women's driving patterns (times of day, day of week, roadways on which they travel, etc.) effected the risk to the driver?
- Do changes in women's likelihood of engaging in risky driving behaviors (speeding, DWI, others) contribute to the increased risk?

The benefits that may accrue from this research are three-fold:

- Safer vehicles—to the extent that vehicle choice is a factor in the increased risk to women drivers, specific aspects of the vehicles may be altered, or women may be convinced to choose vehicles with important safety features or attributes. These could include choosing newer vehicles, larger vehicles, etc.
- Altered patterns—to the extent that women face greater risks by virtue of the times of day, days of the week, or roadways, etc. on which they drive, it may prove possible to develop education programs targeted towards women that can improve safety through reasonable adjustments in driving patterns. Awareness of the specific issues alone could help to reduce the risk.
- Altered behavior—to the extent that women are increasingly more likely to engage in risky driving behaviors, it is clear that education programs can be developed to help reduce the risk.

Key Words: Women, risk, fatality, vehicle safety, driver behavior, driving patterns.

Related Work: The related work on this issue includes NHTSA (and other) studies of risks associated with specific vehicle types, specific driving patterns and specific

behaviors. Some of this research relates directly to women's issues in driving, but the majority of the research has focused on all drivers regardless of gender or other variables that may prove of interest here. A more thorough research review may uncover reports that specifically address gender. It is proposed that the research include a thorough literature review.

Urgency/Priority: To put this problem into perspective an estimated 740 women died in 1996 as a result of whatever factors are causing this steady increase in risk. The cost of these deaths to the nation is in the hundreds of millions of dollars (estimated \$615 million in 1994).

Cost: The cost of pursuing this research program should be in the range of \$45,000 to \$60,000. The range is based on the data sets and numbers of iterations required to develop a compelling picture of the factors for increased risk over the past 20 years. Fatal Accident Reporting System data will be the primary data set for most of the analysis, however, additional data may be required from National Accident Sampling System's CDS or the GES data sets in order to analyze specific issues.

User Community: This research problem statement should go to NHTSA, FHWA, National Association of Governors' Highway Safety Representatives, American Association for Motor Vehicle Administrators, and the auto industry. Each of these organizations represent members who have a vested interest in safety and in the results of any problem identification effort aimed at a specific segment of the population.

Implementation: The results of the research are likely to result in education programs targeted to the needs of women drivers, perhaps with specific subpopulations identified based on age, geographic region, driving patterns or other factors identified in the research. The results may also result in changes to vehicles or perhaps in the way vehicles are marketed, especially to female buyers/drivers.

Effectiveness: 1975 was not an especially "banner year" for safety in the United States. Major strides in safety have been made in the 20-plus years since the baseline period used in the data overview presented here. It is unreasonable to expect that a return to 1975 safety levels for a selected population of women drivers is out of the question. The benefits to the country would be as many as 740 lives saved and a cost savings in the hundreds of billions of dollars. If even a fraction of this benefit is realized, however, the savings in lives and dollars compare favorably to many safety initiatives at the national level—a 10 percent improvement would still result in over \$60 million in savings. Assuming \$2 million are spent on whatever educational components result from the research, the return on investment would be 30-fold.

Contact: Barbara Delucia and Robert Scopatz, Data Nexus, Inc., 201 Suffolk Avenue, College Station, TX 77840-3017; telephone: (409) 260-3400; fax: (409) 260-3500.

Impediments to Trip-Making by Women Age 65 and Older

Problem: Women age 65 and older show a marked reduction in trip-making when compared to younger women. Reduced travel has been shown to be associated with increased risk of isolation, depression and declines in physical health. What stops older women from traveling? Is it the lack of alternatives to driving? Is it poverty and lack of alternatives for low-income people of either gender? Is it not being able to deal with aggressive driving? Are the barriers in community design or in the individual elderly women? The problem is to determine what are the key impediments are to continued trip-making by any and all modes.

Research is needed to identify effective public interventions for overcoming these barriers. For example, if the primary barrier to continued driving is a subjective sense of insecurity or vulnerability, an effective intervention might be on-the-road driver education. This is a different intervention than that of requiring safety improvements in vehicles tailored to protect physically fragile elderly people.

Objective: The object of this research is to establish a foundation on which future public policy on investment in transportation alternatives can be built. The long-range benefits lie in transportation choices that give women safe, high-quality travel opportunities.

Key Words: Independent living, transportation barriers and solutions.

Related work: I am not aware of current work that takes a broad view of impediments to travel by elderly women as seen by the women themselves. There is relevant work done by Sandra Rosenbloom on the travel behavior of elderly women. Nina Glasgow of Cornell University has been working on the transportation needs of the rural elderly. American Association of Retired Persons (AARP) recently published a survey of 750 individuals 75 years and older that explores some topics of consumer views on community transportation options. There is also related information in the Iowa Longitudinal Study of Aging and in the 1993-94 Asset and Health Dynamics Survey Among the Oldest Old. However, there is no work focused on determining and prioritizing the key impediments to travel.

Urgency/Priority: By the year 2020 nearly 18 percent of the population will be over the age of 65. The majority of this cohort will be women and will be living in areas such as suburbs and small town in which the automobile is the primary mode of transportation. Information must be gathered now to develop strategies to assure the continued mobility of this population.

Cost: \$60,000

User Community: University Transportation Centers, American Public Transportation Association, FHWA, National Institute of Health's National Institute on Aging, FTA, U.S. Department of Transportation, Gerontology Society of America, National Council of State Legislatures, ProjectACTION.

Implementation: The primary way to implement the findings of the proposed research is for relevant policy and program developers to develop interventions for overcoming the impediments found by the research.

Effectiveness: Potential societal impacts include reduced isolation for older women resulting in improved social interaction, improved nutrition, and improved physical and emotional health. Relevant measures of effectiveness would include increased travel, particularly by elderly women who live alone.

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Gender Differences in Driver Skill Development

Problem: Motor vehicle crashes are the leading cause of death for 15- to 20-year-olds. In response, NHTSA has developed a graduated licensing program (NHTSA, 1994). While this effort is a giant step forward, the program is only as good as the education it provides. Too many programs in the past have promised change but have failed to deliver.

Research suggests that a number of factors, including gender differences, are important in developing driving skills. We see two implications of gender differences for driver training. First, most training programs are “one size fits all.” They are easy to do, but fail because they ignore critical gender differences. Driver training approaches effective with risk taking young men may be counterproductive for most young women. Spatial perception training, useful for many young women, may be useless for many young men. Sensation seeking, cognitive structures, self-efficacy, and caution may also be important. The next generation of driver training programs must not ignore these gender differences.

The second concern is with the use of supervised driving. We can legislate that supervision will be provided, but we cannot legislate that the supervision will be good. Researchers now know a great deal about gender difference in the training of cognitive skills, perceptual abilities, and judgments (Philben et al., 1995). We must begin to incorporate these differences into driver training.

This research would undertake the work necessary to specify critical gender-linked individual differences. These differences can then be incorporated into driver education programs and into our supervised driving procedures.

Objective: Graduated licensing programs lengthen the period of practice and training for the novice driver. Their success depends upon the caliber of the training and the parental participation. Therefore, the next critical task is to assess the current driver training and supervision and to find ways to improve upon it. One powerful way to increase effectiveness is to tailor training programs to individual characteristics such as gender. The proposed research will:

- Identify gender differences in driving related characteristics including risk taking, sensation seeking, spatial/perceptual skills, cognitive structures, self-efficacy, caution, attitudes, expectations, and experiences;
- Describe the development of driving skills and judgments of young men and of young women so that we know what facilitates good skills and attitudes;
- Specify gender linked training differences and requirements for instruction in order to discover effective training features; and
- Generate specific guidelines for educators and parents that will allow them to adapt to individual differences in skill development.

This research will allow us to summarize the emerging picture of skill acquisition delineated by gender-related characteristics. It will describe how parents fit as partners in the driver training process. Most important, it will provide recommendations so that the next generation of training programs can make our nation's roadways safer for all.

Key Words: Adolescents, gender, cognition, cognitive task analysis, driver education, graduated licensing, naturalistic decision-making, teens.

Related Work:

Overview Young people have an advantage over older drivers in visual capacities, reaction times, and psychomotor skills (Llaneras et al., 1993; Lerner, 1993). Young drivers, however, often lack the complex cognitive skills and the psychosocial characteristics needed for safe driving. Some of these important skills and characteristics show gender differences.

Risk Taking and Sensation Seeking The assumption of invulnerability of adolescence (Elkind, 1984) is linked to the high-risk behavior that characterizes early driving (Klein et al., 1998; Klein et al., April 1997; Vincent et al., March 1998). Sensation seeking describes the seeking of intense experiences and the willingness to take physical, legal and financial risks to create these experiences. Males are generally higher in risk taking and in sensation seeking. Zuckerman and Neeb (1980), suggest that driving is the most common mode of sensation seeking in young men. The recognition of the role of risk taking and sensation seeking in crashes has generated the “blood and gore” films shown in driver education classes. These films are shown to all students, though they may be useless for many. Such films may increase recklessness in very high sensation seekers (Zuckerman, 1994). We need to know the impact of scare techniques for people differing in this attribute.

The concept of caution has been used to describe gender-linked driving patterns. Some drivers, especially women, are dangerously overcautious. They may also have less driving experience because of their reluctance to drive. This difference is important on the roadway. We interviewed one young woman who regularly stopped on the entrance ramp to a limited access highway because she was uneasy with merging. This behavior can be hazardous.

Perceptual Components of Driving Spatial skills are needed to merge onto a busy Interstate, to judge speeds of other vehicles, and to back into a parking place (Halpern, 1992; Gugerty, 1997). Research supports gender differences in spatial abilities. Drivers need to predict the shape or position of an object in the field of view. They need to obtain visual information while traveling at high speeds. They need to anticipate change as a vehicle approaches and passes. If a person is searching for a landmark, recognizing it in different orientations will speed the task. This frees more attention for driving. Spatial skills are a necessity in the complex environments of automobile travel. Spatial skills need to be further incorporated into driver training programs.

Cognitive Components of Driving Traditional driving research has examined driving in laboratory settings. This strategy avoids the complex nature of driving in favor of well-defined tasks within controlled situations. The research provides measurements of reaction time, static visual acuity, and peripheral visual detection. Driving, however, is not a static activity. It takes place in the real world where judgment and decision making

are the difference between safe and unsafe passage. A good driver must track other vehicles, compensate for varying road conditions, and anticipate the behaviors of others.

The Naturalistic Decision-Making model is a recent advancement in cognitive research. It provides methods for exploring the dynamic, time-pressured, high-stakes decisions needed for complex activities like driving. A tool for understanding these decisions is Cognitive Task Analysis (CTA). This interview technique examines cues and tactics as well as self-knowledge and strategies. It allows researchers to describe cognitive understanding of a task. Our laboratory has completed a series of CTA interviews with drivers. Participants ranged from young, novice drivers to mature and professional drivers (Klein et al., 1998; Klein et al., April 1997; Vincent et al., March 1998). We have looked at complex and interacting driving judgments and decision making. This methodology will be useful for exploring gender differences in novice drivers.

Self-Efficacy Self-efficacy describes how people appraise their efficacy or abilities in a domain. Efficacy beliefs are predictive of competent performance in different domains (Bandura, 1997). An inaccurate appraisal of skill may lead to inappropriate behavior and risk taking. Young drivers often underestimate driving risks, but overestimate their skill and ability to avoid crashes. They see themselves as less vulnerable than their peers (Finn and Bragg, 1986; Jonah, 1997). Thus, they are more likely to adopt behaviors such as tailgating and accepting inadequate gaps.

Attitudes and Expectations Because driving behavior is rooted in a social context, we must understand the attitudes and expectations of young drivers. Harré et al. (1996) report gender differences in attitudes and expectations about drinking, traffic regulations, and emotional judgment. Some of these are related to invulnerability, compulsiveness, and anti-authoritarianism. Together, they highlight the importance of attitudes and expectations.

Experiences Inexperienced drivers do not perceive hazards and lack the skills needed to avoid risks (MacDonald, 1994; McKnight, 1997, cited in Gregerson and Bjurulf, 1996). Some crashes, caused by risk taking, would not have occurred if the driver had more experience (Williams, 1997). Practice is critical for skill development. Our nation's graduated licensing programs include guided practice (NHTSA, 1994). Many states are now requiring that young drivers complete a certain number of miles with the presence of a licensed adult driver. The goal is to provide the new driver with broader experience before driving alone. This approach to driver training is consistent with what has been learned in other skilled activities. However, parents are being asked to assume this role in training. To date, little effort has been devoted to identifying and communicating the nature of the role. This makes it timely and important that we learn the nature and impact of these guided practice experiences.

Proposed Research: Past research into the cognitive processes of young drivers has provided the methodological and theoretical foundation for the proposed research. We can now investigate the dimensions of gender that are important for the development of proficiency. The proposed research will document patterns of early driving development

using a range of cognitive, perceptual, and psychosocial procedures adapted for use with beginning drivers. The research would follow 120 new drivers longitudinally through their first year of a graduated licensing program. Interviews, questionnaires, and assessment procedures would explore areas including

- Risk taking and sensation seeking as traits that influence driving judgments as well as caution as a personality trait influencing behavior;
- Spatial abilities, including mental rotation and visualization, needed to control a vehicle;
- Cognitive structures that are important for the judgment and decision making skills needed for successful driving;
- Self-efficacy concerning driving, attitudes, and expectations of young drivers and of their parents before and during the first year of driving experience; and
- Training experiences including parental coaching patterns, classroom experiences, and behind-the-wheel patterns.

Participants: Participants would be 120 adolescents from 15.5 to 16.5 years old at the study's inception: half will be male and half will be female. To participate, the adolescent and a parent must make a commitment to stay with the study for 1 year. A car must be available for regular practice. A subset of the whole group will also participate in a CTA.

Procedures: Data would be collected over the year after the application for licensing. Young drivers would be interviewed at the beginning of the study. The initial interview could cover cognitive structures, experiences, personality traits, and attitudes. Demographic information would also be collected. Each teen would be contacted 4 months after the study begins. This would typically be after the completion of the classroom training and during the supervised driving period. Progress would be assessed and perceptions of the training experience collected. Materials from their training program would be reviewed. Structured interview procedures would be used. At the final interview with the new driver, in the 12th month, attitudes and expectations would again be measured. An estimate of driving experiences including mileage must be obtained. Outcome measures including self-assessment of skill, citations and accidents, and difficulties would be collected.

At 6 months into the study, CTA interviews with the subset of teens should be undertaken. These explore cognitive aspects of driving. These teens would also be in a final CTA interview.

The parent of each participating teen would be interviewed at the beginning of the study questions focusing on knowledge of training approaches, intentions for supervision, and expectations. Parents would also complete a temperament questionnaire for their child. Phone interviews with the parents after 3 months would generate a profile of training style, chart progress, and assess perceived competence. The interviews will allow a description of coaching and its link to success. At 8 months, a final phone interview would be conducted with a parent.

Measurement Tools:

- **Sensation Seeking and Risk Taking.** Consistent with the work of Jonah (1997), the Sensation Seeking Scale as modified to version VI will be used for assessment. Participants are asked to rate their feelings on a scale of one to five. Jonah (1997) suggests that this scale may help identify who is likely to use driving for stimulation.
- **Spatial Abilities.** The most widely accepted method for testing spatial orientation skills is one developed by Shepard and Metzler (1971). The participant is asked to compare two objects in different orientations. Parlee and Rajagopal (1974) use an embedded figure test. Here, an object is presented in two dimensions and the participant is asked if it appears in a second, more complex drawing. We are now exploring the possibility of a computer presentation of both assessments. This may be a more attractive format for adolescents.
- **Cognitive Structures.** A CTA, built on previous work, would chronicle a history of driving experiences for each participant. Early patterns are particularly interesting with focus on the use of cues and on difficulties as well as on knowledge of limitations and strategies for adaptation. Model cars should be available during these interviews to facilitate descriptions of driving situations.
- **Self-Efficacy.** Past research protocols with both novice and experienced drivers provides the basis for a questionnaire. Questions would be designed specifically to identify levels of task demands for and barriers to successful performance of driving. Participants would rate their belief that they can successfully perform these driving challenges.
- **Caution.** The measurement of caution can be obtained from the Revised NEO Personality Inventory, a widely used and validated comprehensive measure of normal personality traits (Costa and McCrae, 1992).
- **Attitudes and Expectations.** Protocols from our past research generate questions concerning the meaning, expectancies, and values of driving for the young person. We will also assess attitudes with the Dangerous Thought Pattern Scale (Harré et al., 1996).
- **Training Experiences.** A profile of training experiences would include details about time spent and content as well as effective features of current practices in the classroom and supervised during time.

Urgency/Priority: Because of the number of young drivers involved in traffic crashes each year and the recognized role of skill and inexperience, NHTSA (1994) has encouraged states to set up graduated driver licensing. While, in the past, only minimal instruction and coached practice have been required, graduated driver licensing mandates an extended period of coached driving for young drivers. While some research exists to guide program development, past research concerning the long-term impact of graduated licensing has come from abroad. Cultural factors may confound outcomes and detract from their usability (Williams, 1997). We need to learn how training can be most effective here.

Thus far, little effort has been devoted to research attempts to differentiate between male and female drivers. It is now imperative that we critically evaluate early learning and driving patterns of male and female adolescents. We will then be able to develop

optimal training and coaching procedures. We must be able to tailor the training to the capacities and characteristics of the individuals being trained in order to reduce crashes, injuries, and fatalities among young drivers.

Cost: \$500,000

User Community: Formal driver education programs that aim to provide quality training are expected to benefit from this research. Trainers can use simple techniques to detect personality characteristics and perceptual skills of their students. This knowledge will allow them to tailor the driving instructions to the needs of individual trainees. For example, tools such as scare movies can be used only for trainees with whom they are likely to be effective. Parents are expected to benefit directly from this research. We have no reason to believe that a parent will know how to teach driving. Parents need to be provided with information to help them optimize their coaching.

Ultimately, the information gained from this research should increase the effectiveness of the graduated licensing program. This increased effectiveness will lead to safer roadway environments for all drivers and pedestrians.

Implementation: At the end of the research period, we expect to be able to provide:

- Specifications of individual and gender characteristics that influence the acquisition of driving skill;
- Specifications for contributions for effective and individualized training programs for young novice drivers;
- Specifications of the information necessary to develop effective computer programs using individual assessment characteristics and tailored training based on those characteristics;
- Guidelines for adults who will be providing the coaching to novice drivers;
- Recommendations for future psychological and psychosocial measurement procedures; and
- Recommendations for a long-term outcome evaluation.

This research is aimed at building better instructional programs. Results would be incorporated into public- and private-sector driving programs.

Effectiveness: Graduated licensing programs have proven to be effective in other nations. Instructional programs are generally most effective when they are tailored to individual characteristics. Gender is a powerful individual characteristic with promise for optimizing learning. It can no longer be ignored as we develop graduated licensing procedures. The effectiveness of the research should be confirmed in a second phase of research. This would follow a second set of subjects who have been trained using insights gained from this initial research. The benefits of improved training and coaching methods can be measured by examining driving practices and records of newly licensed adolescent.

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Examination of the Career Paths of Women in Transportation

Problem Statement: Little research or information exists on the nature of the career paths of women in transportation. The premise of this problem is that women in transportation have had different experiences than men. Although a traditional educational background for transportation-related careers generally included a degree in engineering, more importance is being placed upon interdisciplinary education. Coupled with this dynamic is the fact that the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and its successor, the Transportation Equity Act of the 21st Century (TEA-21), has placed increasing importance on interdisciplinary approaches to address transportation issues. This study involves an effort to better understand the career path of female transportation professionals with the objective of noting any linkage between educational background and career advancement.

A survey could be administered to transportation professionals who are members of professional groups, e.g., the Women's Transportation Seminar (WTS). Individuals would be randomly chosen. Subjects involved in this research would be asked to fill out a questionnaire.

Objective: This research would provide information on the career paths of female transportation professionals including data on their educational backgrounds, career advancement opportunities and professional transportation experiences. This information will be useful to transportation-related firms and organizations as well as by educational institutions for recruitment and retention of individuals in the field. In addition, this study could provide information on how educational background is viewed by women in transportation as significant in their career stability and advancement.

Key Words: Education, transportation planning, WTS.

Related Work: The most closely related work in this area was highlighted in the article, "Education and Training Needs of Women in Transportation," included in the *TRB Special Report 210* completed in 1984 by the National Research Council. This work is somewhat dated now and does not address current dynamics of the transportation profession including: the implementation of ISTEA, TEA21, interdisciplinary degree programs, University Transportation Centers Program (UTCP) and the role of metropolitan planning organizations. Members of WTS from New York, Philadelphia and Washington, D.C. were consulted for their views on the unpublished 1983 WTS Educational Survey and a 1980 American Public Transit Association (APTA) report.

The article "Reentry of Women into the Transportation Profession: Program and Potential," *TRB's Transportation Research Record 929*, also has provided insight on this issue. This research was sponsored by the National Science Foundation (NSF) and demonstrated the ability of many women to quickly adapt to a technical profession.

Urgency/Priority: From the problem statement, objective and related work, one can note the priority of completing updated research on women in transportation. In this decade, there are an increased number of women who hold administrative positions in the

transportation field. There are also a substantial number of women who run their own businesses or are very successful in the private sector of transportation. This research should be considered timely as we seek to recruit new transportation professionals through programs like the Garrett A. Morgan Transportation and Technology Futures Program and the University Transportation Centers Program (UTCP). Information garnered through this research will impact the profession as we move into the 21st century.

Cost: \$60,000-75,000. Approximately \$15-\$25 per survey using the mailback method. The cost variability would be due to follow-up mailings, number of open-ended questions to code and desired statistical processing.

User Community: The general audience for this research is transportation professionals. Organizations such as WTS, APTA, TRB, NSF, and state and federal transportation agencies will benefit from the results of the survey. This work may serve as a resource for recruitment/retention efforts at educational institutions and within the public and private workforce.

Implementation: The results of this survey may largely be incorporated into existing programs. The areas which would benefit from the analysis include career placement offices, university programs in transportation, WTS, mentoring programs in transportation and continuing education programs in transportation.

Effectiveness: This study will add to the general body of knowledge on transportation as a career. It will also provide insights for career options for women. Feedback on specific courses or programs that were beneficial to the career advancement of the respondents may be useful to university transportation programs. Measures of effectiveness include an increase in the number of women entering the field of transportation, an increase in the number of women retained in the field of transportation, and the successful advancement of women in transportation.

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Workshop on the Feasibility of a Joint Strategy for Welfare Reforms and Advanced Vehicle Deployment

Problem Area 1: FHWA's goal of providing mobility alternatives to welfare recipients is hindered by the fact that only 5.5 percent of the Temporary Assistance for Needy Families (TANF) recipients own vehicles. A typical TANF recipient is a single mother 25 years old or older, with two children, and with, at most, a high school education. With the growing sub-urbanization of jobs, many of these jobs can not be reached by transit. As a result, this situation limits the job opportunities for TANF recipients.

Problem Area 2: The Department of Energy's (DOE's) goal of deploying "greener" vehicles (such as alternative-fueled vehicles and super fuel-efficient vehicles) is hindered by public acceptance. Many factors contribute to consumers' disinclination to purchase an alternative fueled vehicle (AFV) at this time—the lack of refueling infrastructure being one. Meantime, the limited number of AFVs does not provide adequate motivation for investment in alternative fuel infrastructure—a classic catch-22 problem.

Possible Solution: A strategy that can simultaneously address both of the aforementioned challenges is to provide adequate incentives to new vehicle buyers if they donate their used vehicles to welfare recipients and if they replace their donated vehicles with an AFV.

Objective: To conduct a workshop of all stakeholders (including fuel providers, auto industry, vehicle buyers, etc.) to brainstorm the feasibility of a joint strategy for welfare reforms and advanced vehicle deployment, and to identify and address practical, logistic, liability, and deployment issues.

Key Words: Welfare reforms, cars for working poor, Welfare to Work, clear vehicles, green vehicle market, sustainable community.

Related Work: Work has been conducted individually on Welfare to Work, paratransit, and deployment of clean vehicles. However, no work has been done on a joint strategy as proposed.

Urgency/Priority: Now is the time to brainstorm and develop innovative alternatives to help address two key priorities: protecting public health and the environment, and creating opportunity for all Americans.

Cost: \$30,000

User Community: FHWA, FTA, DOE, Department of Health and Human Services, American Public Welfare Association, Environmental Protection Agency.

Implementation: The product of this proposed workshop will be a strategic plan, outlining future steps and issues to be addressed.

Effectiveness: The impact of this proposed joint strategy can be measured from many perspectives: reduction in greenhouse gas emissions and critical environmental pollutants, increased national security, increased transition of lower-income workers from Welfare to Work, and improved economy.

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Enticing Aging Baby Boom Women Back to the City

Problem: The baby boom has been the demographic engine driving social change in the United States for the past 50 years. Unlike their mothers and grandmothers, significant numbers of baby boom women have earned college degrees, entered the labor force, and maintained their own households. Baby boom women also are more likely to have drivers' licenses than women who are elderly now. Data from the 1995 Nationwide Personal Transportation Survey (NPTS) suggest that female baby boomers will be more likely to own cars, will make more trips, and will drive more miles when they reach ages 75 and over than older women do now. Thus the transportation profile of baby boom women will look more like their fathers' than their mothers' when they reach the oldest ages. These trends raise important issues for the future:

1. How will localities prepare for the additional traffic generated by older women drivers?
2. How will older women maintain the independence to which they have become accustomed when their ability to drive declines?
3. When they can no longer drive, what demands will older women make on government services to compensate for the loss of mobility?

Objective: The objective of this research is to find ways to avert some of the most predictable transportation consequences of an aging population by encouraging central city residence. Given the current suburban distribution of population, commerce, and jobs, baby boom women's current travel patterns portend both additional gridlock and pollution and restricted personal mobility as ability to drive declines. Appropriate policies might avoid this scenario. More than 20 years of federal highway and mortgage subsidies unwittingly created the suburbs, and we now have almost 20 years to implement comparable public and private incentives to intentionally encourage central city residence as the baby boom approaches retirement age.

Key Words: Elderly, gentrification, urban revitalization.

Related Work: This research would build on the work begun by Sandra Rosenbloom in "Travel by Women" and "Travel by the Elderly" [Demographic Special Reports: 1990. NPTS Report Series, U.S. Department of Transportation (DOT), 1995]. Other relevant work includes Wachs' and Crawford's "The Car and the City: The Automobile, the Built Environment, and Daily Urban Life" (University of Michigan Press, 1992); Howe et al.'s "Planning for an Aging Society" (American Planning Association, 1994); and Lang et al.'s "Targeting the Suburban Urbanites: Marketing Central City Housing" (Housing Policy Debate 8, 1997, pp. 437-470).

Urgency/Priority: This is an extremely urgent issue because of the size of the baby boom cohort, its political influence and the continued growth in vehicle miles traveled (VMT) due to land-use decisions that encourage suburban and exurban sprawl.

Transportation professionals have less than 20 years to address the demands and needs of the aging population, the majority of whom will be women who vote.

Cost: \$200,000

User Communities: FHWA; Department of Energy (DOE), Environmental Protection Agency, Social Security Administration, National Institute of Health's (NIH's) Institute on Aging, Department of Housing and Urban Development (HUD).

Implementation: A national "back to the city" campaign aimed at baby boomers would require the cooperation of several federal agencies. FHWA could take the lead by create a team of middle managers from the DOT, DOE, HUD, the Social Security Administration, and the NIH Institute on Aging to coordinate efforts to encourage central city residence and private enterprise. Like the Joint Agency Task Force on Fair Housing and Civil Rights formed by President Clinton, a Joint Agency Task Force on Cities for Seniors would be responsible for keeping the big picture in mind: How do decisions made by individual agencies collectively influence the national goal to promote central city residence?

Effectiveness: The baby boom cohort has had a significant impact on schools, the housing market, and the health-care system as it has aged. Transportation will be next. Encouraging central city residence could enhance the quality of life for the elderly and non-elderly alike, reduce pollution, and maximize the use of existing urban infrastructure. The relevant measure of effectiveness would be a decline in the rate of VMT growth.

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Changes to the School Bus Transportation System Since 1929 and Recommendations for the Future

Problem: The school bus transportation system in the United States has implemented many safety standards to ensure the safe transport of our children. These changes include modifications to structural components; driver, passenger, and pedestrian training programs; laws for all drivers and passengers; and inspection standards. However, other changes to school buses may have been implemented on a local level but never advertised widely.

Objective: The objectives of this problem statement are

1. to survey various components of the bus transportation system to identify and evaluate special programs for school buses;
2. to document lessons learned from these programs that have been initiated;
3. to obtain suggestions for innovative changes; and
4. to recommend near-term and future actions or programs for implementation.

After determining the suite of efforts that have been attempted and those that have been recommended, the research would rank the programs based on feasibility, value (to students, bus driver, contractors, school system), and cost benefit and would provide a list of recommended enhancements to the school bus transportation system.

Key Words: Safety, education, survey.

Related Work: The NHTSA has implemented many programs to enhance the safety of school children. The National School Transportation Association works with government, the public sector, and bus contractors to bring about improvements in pupil transportation. The *School Transportation News* has reported on various innovations.

Urgency/Priority: Safety is relative. A few years ago, children did not bring firearms into classrooms to kill teachers and classmates. It is important to survey the school bus transportation community to identify problems in advance of a horrible event and to take action to prevent its occurrence.

Cost: The approximate cost of the survey and its analysis is \$150,000.

User Community: The audience that should receive this problem statement includes the FHWA, NHTSA, and the Department of Education. Possible recipients include the National Association for Pupil Transportation, the National School Transportation Association, and the National Association of State Directors of Pupil Transportation Services.

Implementation: The survey design should encourage electronic submission to lessen the costs of manual data entry. If possible, the population receiving the survey should

include bus drivers, bus contractors, students, teachers, safety officers, and school administrators. In addition to “typical” survey questions, the survey will include some open-ended questions to elicit creative suggestions. The survey might be implemented through the National School Transportation Association or through a sample of school districts in each state. After analysis of the results, recommendations for action would be formulated.

Effectiveness: It is important to understand that the school bus carries children for an average of about 1 hour a day. This is critical time which must be a safe time, but which should be used to enhance the child’s education. We have addressed safety issues; now it is important to address how to spend the time on the bus effectively.

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School Bus Intelligent Information System for Collecting and Disseminating Location Information

Problem: Although fatalities involving school buses are relatively rare, any accident or delay involving a school bus causes a parent to worry. Currently, there is no mechanism, except the radio and television, for alerting a parent concerning a delay, the cause of a delay (weather, accident, mechanical breakdown, etc.), the duration of the delay, or the actions that the parent should take. The proposed School Bus Intelligent Information System will provide information to school administrators but will primarily benefit the parent, usually the mother, who is responsible for getting the child on the school bus in the morning and greeting the child when he arrives home in the afternoon.

Objective: The objective of this research is to determine a methodology for an efficient, cost-effective, accurate, secure system that will track individual school buses and communicate appropriate information to the school system's central administration unit, the school transportation administrator, and to parents of children on the bus. In a rural environment, children may spend a significant part of each day riding to school on a bus. The greatest benefit of the proposed information system is that parents and officials can always know the location and condition (these "conditions" would vary depending on the needs of a particular school system) of the school buses. In case of an accident or mechanical problem, when emergency crews are needed, they can be dispatched almost immediately with a full understanding of the problem and the exact location of the bus. In addition to being able to track the bus while the child is on board, parents will be able to determine the location of their child's bus prior to its arrival in the morning in order to prevent the child from needing to wait outside in inclement weather. The information available to parents can also be expanded to include maps of limited routes (e.g., snow routes).

Key Words: Global Positioning Satellite (GPS) technology, wireless communication.

Related Work: Statistics have been collected by the U.S. Department of Education's National Center for Education Statistics on the numbers of pupils transported and the expenditures for transportation. The NHTSA has programs to enhance the safety of school children. The National School Transportation Association works with government, the public sector, and bus contractors to bring about improvements in pupil transportation. Modern urban transit systems currently use GPS technology and wireless communication to track buses.

Urgency/Priority: The recent spate of violence on school campuses and at school events sparks fear in every mother's heart that her child could become a victim. A methodology by which parents could stay in touch with the child during transit between the home and the school or school-sponsored activity would allow parents to address and alleviate their anxieties. The time is now to conduct the research to determine the best means to accomplish these goals and to initiate a program for integration of a school bus intelligent information system for our yellow school buses.

Cost: A feasibility study to conduct research to determine the system design which is most user-friendly and cost-effective and to provide a cost analysis for various options that consider variable conditions across the United States would cost about \$35,000. The estimated cost for the development of the initial pilot system and evaluation of its design is \$250,000 (dependent on the results and recommendations of the feasibility study).

User Community: The audience that should receive this problem statement includes FHWA, NHTSA, and the Department of Education. Possible recipients include the National Association for Pupil Transportation, the National School Transportation Association, and the National Association of State Directors of Pupil Transportation Services.

Implementation: One possible design includes the use of the GPS system, an onboard device for collection of the desired information (GPS location data and possibly other data such as speed or number of children on board), a wireless communication system transmitting information from each bus to a central data processing unit, software to convert the location and condition information to a graphical display, and a methodology for communicating this information to parents.

Plans for implementation include conducting research to determine the existence of similar information systems that could be adapted for use on school buses and to conduct an evaluation of their effectiveness. A pilot system is recommended for a limited number of buses to evaluate the design and the cost-effectiveness of the system. The next phase would be to revise as necessary and implement the information system for an entire school district for a limited time frame (e.g., 1 year). If the system proves valuable and cost effective, it should be implemented throughout the United States at the earliest possible time.

Effectiveness: The users of such an information system would be primarily rural school systems that use “yellow” school buses to transport children to and from school. Both school administrators and transportation coordinators would be able to monitor bus activity in the mornings and afternoons. In addition, parents could monitor the location of buses, on which their children ride and would be aware of delays. Unauthorized persons would not be able to access the system.

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Educommuting: Bus Broadcasting System for School Buses

Problem: Every morning and every afternoon, bright yellow school buses traverse the countryside transporting close to 60 percent of the nation's youth to school and back home, just as they have done for over half a century. During that same period of time, media technology has changed dramatically. Many, if not most, U.S. households own a cell phone, a personal computer, and at least one television. But yellow school buses continue to pick up and discharge children just as they did 50 years ago. In this day of increased emphasis on the need for better-educated youth, we propose a new application of advanced media technology. A portable classroom, designed from both a technological and a functional viewpoint especially for use on school buses, will provide enrichment learning opportunities for rural youth.

Objective: This research will

1. Determine current and future technology options;
2. Describe functionality; and
3. Build a working prototype for a Bus Broadcasting System for school buses. The Bus Broadcasting System will provide educational opportunities for children who spend part of each school day on school buses.

Key Words: Portable classroom, educational programming, satellite tracking, high-definition television, data communication, wireless technology.

Related Work: Scholastic's *The Magic School Bus* is a television project that takes students on educational field trips. Channel One programming provided current events for students (but also included advertisements). Fame Tours of Florida transports students for special events. Each tour bus has three video monitors (front, middle, back of the bus) and has speakers at each seat. A spokesperson for Fame Tours indicated that showing videos is a definite safety feature in that the students are quieter and the driver has fewer distractions.

Urgency/Priority: As our nation becomes more urban, it might seem that fewer children use school buses to get to school; however, since the early 1980s, the percentage of children riding yellow school buses has remained around 60 percent. Based on a limited research sample (four county school systems in east Tennessee), the average length of time spent on the bus is about 30 min per route (i.e., a total of 1 h per day). This hour is a marvelous opportunity to provide educational opportunities for these children. In addition, if the programming becomes a "hit," then a greater percentage of children would want to ride the bus, which implies fewer trips by parents to take children to school. Finally, the system, because it will be designed to be interesting as well as informative, will help maintain discipline on the bus.

Cost: The cost of a feasibility study to accomplish two basic tasks—examine current and near-future technology options and to recommend a methodology for progressing with the

state of the art in the most cost-effective manner and design a week of programming modules estimated to be \$70,000. This estimated cost to build a working prototype, implement it on a limited basis, and evaluate it is \$500,000 (dependent on the results and recommendations of the feasibility study).

User Community: The audience that should receive this problem statement includes FHWA, NHTSA, and the Department of Education. Possible recipients include the National Association for Pupil Transportation, the National School Transportation Association, and the National Association of State Directors of Pupil Transportation Services. Sponsors of related programming include the National Science Foundation, Microsoft Home, the U.S. Department of Energy, and the Carnegie Corporation.

Implementation: Currently technology does not exist to receive streaming video from either television or satellite signals on a moving school bus covering rural, mountainous, tree-covered terrain. However, the potential exists just “over the horizon.” Therefore, now is the time to initiate and evaluate programming modules to be in a position to implement real-time delivery when the technology becomes more mature and stable.

Therefore, the current research would serve to design a technological plan for the future while developing the functionality of the system using existing technology. The functional programming modules would be designed in small increments of 5-10 min so children can start watching as soon as they board the bus and complete between one and six vignettes each trip. It must be remembered that all ages ride the school bus so the programming content must have a wide appeal. The morning programming module might contain a “question of the day”; an interesting fact about today in history; special themes that could span an entire week such as transportation issues, environmental problems, or health topics; training on making wise decisions; information about career options; travel; science and nature programming; and current events. In the afternoon, the programming could be more relaxing and emphasize music, art, drama, or national themes (e.g., Women’s History Month).

A pilot system is recommended for a limited number of buses to evaluate the design and the cost-effectiveness of the system. The next phase would be to revise as necessary and implement the Bus Broadcasting System for an entire school district for a limited time frame (e.g., 1 year). If the system proves valuable and cost effective, it should be implemented throughout the United States at the earliest possible time.

Effectiveness: The impact of such a system could be astounding. While we hear about “year-round” school, the simple addition of an hour a day of enriched learning opportunities for our rural children might be the edge they need to succeed.

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Profiles of Courage: Effective Women's Leadership Case Studies in the Transportation Industry

Problem: Within the transportation industry there is an increasing number of women in the management ranks of both private and public sector organizations. However, while the percentage of women holding management positions has grown since the 1980 census, there have been limited changes throughout the transportation industry. Although there is growing recognition that diversity of the workforce can benefit the respective organization, there is still resistance to supporting a more diversified management profile and limited documentation demonstrating how the entry of women to senior management ranks benefits an organization.

The growing presence of women in senior management ranks of both public and private sector organizations should provide a strong track record for:

1. Documenting the effective management styles of women managers within the industry with special attention to gender differences;
2. Sharing and profiling case studies of organizations that effectively assimilate/appreciate management differences; and,
3. Contributing towards more extensive changes within the industry through a range of programs, e.g., mentoring, and awards for outstanding organizations within the industry.

Objective: To increase the recognition of the differing management types of women and their effectiveness.

Key Words: Leadership, women managers.

Related Work: Unknown.

Urgency/Priority: With more and more attention to effective leadership styles for the changing workforce and marketplace and community demands, it is timely to increase the awareness of the value of different leadership styles, particularly understanding how gender differences can add value.

Cost: \$300,000

User Community: Transportation professionals (public and private), university business schools, university transportation centers.

Implementation:

Step 1: Convene a cross section of women in executive and senior management positions across the modes of transportation to identify barriers and incentives for women reaching executive and senior management levels. Then propose programs for

1. Documenting effective management case studies given women's contributions;
2. Disseminating information about effective women's management styles; and
3. Reinforcing organizational level commitments for developing organizational environments conducive to more diverse management styles.

A representative group of women would be invited to a 2-day brainstorming meeting to develop the framework to meet these objectives. A professional facilitator would conduct the meeting.

Step 2: Develop a pilot program to implement the recommended strategies from the meeting in Step 1. The program would supplement the limited management literature, provide peer pressure for organizational change, and provide forums for women managers to network and receive broader peer support as they assume management roles throughout the industry.

Effectiveness: Broader recognition of the value of alternative leadership styles and use of the literature in recruiting processes and trade programs.

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Best Practices for Advancing and Expanding the Participation of Women in the Transportation Industry

Problem: The transportation industry is composed of a work force that has a 20 percent participation rate of women. While there are some categories that have higher percentages within the industry, this represents a major business issue facing our industry. With increasing attention to become more customer driven, our industry serves customers with profiles composed of at least 50 percent women and often much higher. Since many of the day-to-day decisions, as well as longer term focus, must consider the needs and preferences of its female customers, the organizations and businesses that more closely reflect the diversity of the marketplace have the potential for being more responsive. The more responsive institutions are the greater the potential for gaining either the competitive advantage for private sector organizations or gaining greater support and advocacy for the public oriented institutions.

There are organizations, businesses and industries that have been more effective in attracting and retaining a greater rate of women participation in their respective organizations. However, it takes commitment and understanding of how the many elements fit together to provide the type of environment to support such a strategic imperative. Catalyst, a national advocacy and research organization that works to advance women in management and executive positions, recently documented some successful case studies of businesses that have effectively contributed toward the increased participation of women in their respective organizations or industries in the book *Advancing Women in Business*. Tapping into that research would provide the basis to begin to collect best practices that our industry could examine as it considers options for establishing an aggressive program to increase the participation rate of women in the transportation industry work force.

Objective: The objective of this research is to identify effective approaches that other industries have used to strategically increase the participation of women in their industries and/or companies and to proactively disseminate the findings and advocate for pilot programs to increase women participation in the transportation industry.

Key Words: Women, career development.

Related Work: Catalyst, a nationally recognized not for profit organization, recently published a guide, *Advancing Women in Business*, that demonstrates effective best practices used at progressive businesses.

Urgency/Priority: This is an extremely urgent issue given the tightening labor market and the growing pressure for our industry to be more customer/market driven. With much of our customer having significant percentages of women making many choices, the transportation industry would benefit from a workforce that more closely reflects its customer profile.

Cost: \$200,000

User Community: All transportation agencies/organizations.

Implementation:

Phase One: Conduct a literature search of the best practices with representative industries including identifying possible models within the transportation industry to determine the conditions and strategies that support the goal of increasing the participation rate of women in the transportation industry.

Phase Two: Convene a cross-section of industry leaders to review the research and identify and recommend possible models to test in the industry.

Phase Three: Publish the findings and recommendations for dissemination at major transportation professional association meetings, conferences, and trade journals.

Effectiveness: Measures of effectiveness include an increase in the rate of women participating in the transportation industry.

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