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Key Discussion Points and Findings

Synthesized in this chapter are the key discussion points and findings in this report, which underpin the study committee's responses to the questions in Chapter 1. These findings are organized according to the chapters from which they are drawn.

BACKGROUND (CHAPTER 2)

Interest in fully automated driving extends back more than 50 years. Early researchers anticipated the planned advent of fully automated, hands-off, feet-off vehicles and highway systems that would greatly improve the comfort and convenience of motor vehicle travel.

More recently (starting in the 1980s), burgeoning interest in automated driving coincided with the growth of interest in intelligent transportation systems (ITS) generally. As part of ITS research and development efforts, attention has been given to systems that can warn a driver of a potential collision, possibly take control of a vehicle in an emergency, or automate certain driving (tasks such as maintaining a safe following distance from other vehicles in traffic). Developments in other types of ITS, such as route guidance and traveler information systems, often have been viewed as complementary, with the potential to merge eventually with crash avoidance systems and other partial-automation features to provide fully automated driving.

The 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) called for early prototype development and testing of a fully automated vehicle and highway. This mandate prompted the U.S. Department of Transportation (DOT) to create the National Automated Highway System Research Program. The goal of the program was to develop specifications for a preferred fully automated highway system concept that would provide the basis for future development of supporting vehicle and highway technologies. DOT planned to devote approximately 10 percent of its ITS research and development budget to this multiyear effort.

To pursue these goals, DOT established the National Automated Highway System Consortium (NAHSC). This consortium consisted of nine leading organizations from academe and the public and private sectors, including representatives from the vehicle, highway, electronics, and communications industries. This collaborative approach—in which the federal government was expected to pay 80 percent of program costs—was chosen to expand the program's expertise, resources, and perspective. A diverse and prominent membership also was considered essential to building interest in and support for the early development, testing, and deployment of fully automated systems.

NAHSC was directed to gain a better understanding of the range of full-automation concepts, as well as the needs of prospective developers and users of these systems, termed "stakeholders." The consortium was expected to stage the demonstration of automated vehicles and highways by 1997. Its ultimate goal was to specify, develop, and test a preferred fully automated highway system.

NEEDS, CONCEPTS, AND ISSUES (CHAPTER 3)

The need to further reduce the incidence and severity of motor vehicle crashes and the need to increase the efficiency and capacity of the highway system offer compelling reasons for ITS research and development in general. These same needs underlie efforts to develop fully automated vehicle and highway systems.

Demand for motor vehicle travel has grown, and continues to grow, at a rapid pace. By comparison, the size of the road system is relatively static. Expanding highway capacity to keep pace with travel demand is increasingly difficult and costly. State and local transportation agencies are finding it impractical to build more highways and travel lanes in many urban areas. ITS developments such as electronic toll collection, computer-synchronized traffic signals, and travel information systems are helping to improve the operations and efficiency of highway networks around the country. Uncertainty about whether the additional capacity gained from these efforts will be sufficient has spurred interest in fully automated vehicle and highway systems.

Impressive gains have been made in highway safety over the past three decades. One area that has been most difficult to address, however, is the large share of crashes caused by driver error. Advanced technologies, such as collision warning systems that would aid motorists and possibly take control of the vehicle in an emergency, could help reduce crashes attributable to driver error and poor performance. The safety potential of these systems remains unclear, especially because of the need to integrate their performance with human factors such as the behaviors and capabilities of drivers.

Even less certain is the overall safety effect of fully automated driving, which would depend on how and where these systems were deployed as well as assurance of their safe operation. The safety potential and reliability of fully automated systems and associated human factors issues have not received significant research attention.

Some advanced vehicle systems—possible precursors to full automation of routine driving tasks—are far along in development, and a few (such as radar-based collision warning systems) have been introduced in the marketplace. Systems that support fully automated driving presumably would incorporate many of these precursor features. Many technology combinations and configurations are possible, though their feasibility remains uncertain. Full-automation concepts currently being explored range from those that would involve autonomous vehicles driven automatically, primarily through the use of in-vehicle systems, to those that would involve close communications and cooperation among vehicles and between vehicles and highway infrastructure. An example of the latter concept would be platoons of vehicles operating at high speeds and in close spacing on lanes dedicated to fully automated travel; such systems would yield substantial gains in traffic throughput.

Alternative concepts of full automation raise different technical, institutional, environmental, and economic issues. No single concept is likely to be most suitable with regard to all of these issues; trade-offs undoubtedly would be required. Understanding all of the issues and ramifications of different automation concepts and determining the trade-offs that would be acceptable to users and providers of the system present significant challenges to early identification of a preferred fully automated highway system concept.

NATIONAL AUTOMATED HIGHWAY SYSTEM RESEARCH PROGRAM (CHAPTER 4)

The National Automated Highway System Consortium was created by DOT in 1994. The composition, structure, and procedures of the consortium were specified by DOT with the goals of staging the congressionally mandated demonstration and identifying and building support for a preferred automated highway system concept. DOT recognized that early specification of a system would require broad and deep support by transportation users and providers and directed the consortium to develop active outreach and public relations programs. The consortium also was encouraged to make all key decisions by stakeholder consensus.

The magnitude of the consortium's task (to assess the technical as well as the practical feasibility of alternative systems), its dual roles as evaluator and promoter of fully automated highway systems, and the resulting organiza-

tional and decision-making processes combined to present a very difficult challenge. The effort required to undertake the congressionally mandated demonstration and shortfalls in federal funding made this challenge even more imposing.

The consortium nevertheless diligently pursued its charge—staging the demonstration, actively reaching out to the transportation community, and exploring many technical and nontechnical issues regarding the feasibility of alternative automation concepts. These efforts, however, tended to raise many more issues than they resolved, further illuminating the difficulties inherent in specifying and generating support for a fully automated highway system at this early stage. As these difficulties became more evident, the consortium was unable to build significant support for the specification of a fully automated highway system, despite extensive outreach and promotional efforts.

The consortium's ability to reflect on its initial findings and experiences and modify its mission and work plan was limited by its consensus decision-making process, its emphasis on promoting fully automated highway systems, and the absence of independent means of assessing its work and direction. These shortcomings became most apparent when it became necessary—and proved difficult—for the consortium to respond to DOT's changed priorities. Inasmuch as the consortium's mission, organization, and processes were devised with a particular vision of how a fully automated highway system could emerge, its prospects for pursuing a much different vision were limited.