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Transportation Research Board

July 26, 2001

Dr. Christine M. Johnson
Program Manager, Operations
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Federal Highway Administration
400 7th Street, S.W.
Room 3401
Washington, D.C. 20590

Dear Dr. Johnson:

The Committee for the Review of the Intelligent Vehicle Initiative (IVI) held its fifth and final meeting on May 2–3, 2001, in Washington, D.C. The enclosed committee roster indicates the members in attendance.

The purpose of the meeting was for the committee to conduct its final review of the IVI program and to prepare this, the last of three letter reports. The agenda was organized to furnish an update on program developments and progress on continuing activities so the committee could provide its final comments on each of the four key questions raised by the U.S. Department of Transportation (DOT) program sponsor at the outset of the study:

1. For the amount of money DOT can invest in this research effort, is the government doing the right things? Is DOT investing its money and human efforts wisely?

2. Is the planned human factors research enough? Is it appropriate?

3. What proportion of effort should be invested in nonpassenger (i.e., truck, bus, and specialty) vehicle platforms?

4. Is DOT's relationship with the industry appropriate?

Before turning to these questions, I would like to extend the committee's thanks to the DOT staff for their helpful overview of program progress to date. Special thanks are due to Jeffrey Paniati, who spoke to the committee concerning the issue of private-sector involvement in the IVI program, and to Raymond Resendes for his succinct program update. The committee also thanks Michael Perel for his update on the IVI human factors team and its progress. Finally, particular appreciation is extended to Dennis Judycki and other DOT staff for their presentation on work related to intersection

crashes and IV technologies currently under way at the Federal Highway Administration's Turner-Fairbank Highway Research Center.

This letter report presents the consensus findings and recommendations of the committee (highlighted in bold). **In summary, the committee believes the IVI program represents an important initiative in meeting the challenge faced by government and industry to advance the rapid deployment of new technologies on highway vehicles for improved safety. The program is showing progress, and the committee applauds the responsiveness of program staff to recommendations for improvement made by this committee. Opportunities for further progress remain, however, in two key areas: greater high-level private-sector involvement in the program and a more visible leadership role for DOT on human factors issues.**

The remainder of this report is organized as follows. First, general comments are provided about the program and the context in which it operates, and key areas of progress since the program's inception are noted. More detail is then provided about the areas in which the committee has focused the majority of its attention—DOT's relationship with industry and the role of human factors[1] in the program—responding to the initial questions 4 and 2, respectively. Finally, the committee comments briefly on questions 1 and 3, which deal with program funding and allocation of resources.

PROGRAM OVERVIEW

The IVI program has an important role to play in a rapidly changing automotive environment. When the program was conceived in 1997, there was a perceived need for government intervention to facilitate industry development and deployment of safety enhancing vehicle-based driver assistance technologies, such as collision warning systems.[2] Since then, industry has recognized the marketability of such devices and is moving rapidly to commercialize them. For example, night vision and back-up obstacle warning systems are already available on vehicles without having had the benefit of

[1] Human factors is an interdisciplinary field of study in which an attempt is made to apply experimental findings from behavioral and life sciences to the design of machines, operations, and work environments so they match human capacities and limitations (Chapanis 1959, vii). The aim of human factors research is to optimize the human–machine interface in order to reduce human error and accidents and increase comfort and efficiency. Human factors research is also concerned with behavioral responses to system complexity, for example as associated with increased automation. Too much automation can lead to operator complacency and inattention. On the other hand, when automation fails or acts in unanticipated ways, or when the normally required human sensing and control actions are too numerous or too complex, the operator can be overwhelmed.

[2] DOT has categorized IV technologies from the point of view of design into two categories—safety enhancing and safety impacting. Safety enhancing technologies, which represent the major focus of the IVI program, are directed specifically toward enhancing driver performance through such means as forward collision warning systems, automated cruise control systems to maintain adequate vehicle headway, and night vision enhancement systems (JPO 1999, 4–7). Safety impacting technologies, by comparison, are those aimed primarily at providing convenience or comfort (e.g., route guidance and navigation systems, cellular telephones, in-vehicle computing) whose use may affect driver attention and workload, and hence safety (JPO 1999, 7).

testing and evaluation through the IVI program prior to their introduction in the marketplace.

In addition, the automobile industry has fully embraced the products of the revolution in information technology. The industry and its suppliers are investing heavily in such technologies as navigation systems and Internet and e-mail access that are already or will soon become available on many new cars. The proliferation of these safety impacting technologies, as they are categorized in the IVI program, has the potential to overload or distract the driver, with negative consequences for safety. In its second letter report, the committee urged that, over time, the IVI program shift more of its resources to addressing the effects of these technologies on safety, broadening the strategic vision and mission of the IVI program.[3] The committee continues to believe in the importance of this recommendation, and urges that more be done to move in this direction.

The IVI program provides a mechanism for government–industry collaboration to harness advances in IV technologies for safety, or at least to minimize any potentially adverse safety effects. Powerful incentives exist for such a cooperative effort. DOT has an obvious role to play, acting in the public interest to help ensure that both safety enhancing and safety impacting technologies do not have adverse affects on or unintended consequences for safety. Similarly, the automobile companies and their suppliers recognize that rushing technologies to commercialization without adequate consideration of their effects on drivers could result in the introduction of safety-diminishing products and ultimately invite government regulation. Cooperation between government and vehicle manufacturers is also needed to ensure the development and deployment of uniform fixed roadside infrastructure technologies that can interact with intelligent vehicles to help drivers avoid intersection collisions and road departures. In the committee's view, cooperative agreements—such as the newly signed Crash Avoidance Metrics Partnership (CAMP) between DOT and five automobile companies[4] and the longer-standing infrastructure consortium between DOT and three state departments of transportation[5]—are a good way to encourage collaboration by involving those who not only design but also deploy the technologies.[6]

Given its ambitious goals but modest budget, the program has made considerable progress since the committee conducted its first review nearly 3 years ago. Field tests of

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[3] The primary thrust of the IVI program and the vast majority of its resources (87 percent of fiscal year 1998–2002 authorizations) are focused on facilitating the development of safety enhancing technologies. A minor part of the overall IVI program mission and a correspondingly small portion (13 percent) of the program budget are devoted to evaluating safety impacting technologies. The committee recommended a level of investment that would be more commensurate with the rapid pace of deployment of these technologies. A copy of the committee's second letter report can be found at www4.nationalacademies.org/trb/onlinepubs.nsf/web/Reports.

[4] The automobile companies include Ford Motor Company; General Motors Corporation; DaimlerChrysler Research and Technology, North America, Inc.; Nissan Motor Company, Inc.; and Toyota Motor Corporation. Navigation Technologies Corporation—a digital map database supplier—is also a partner.

[5] The three core state DOT members are California, Minnesota, and Virginia.

[6] The committee recognizes that a request for proposals–contracting approach is appropriate for certain tasks, such as field operational tests and specific research studies, but the narrow task-focused contracting approach is limited in encouraging collaborative problem solving.

many promising safety enhancing technologies are being conducted. A new human factors team has been established to provide more visibility to critical human factors issues and better integrate them into the program. Finally, work is under way on developing a framework for the evaluation of candidate IV technologies, initiating the major task of gathering baseline data on precrash driving behavior, and measuring program progress through an annual report.

These are important accomplishments, particularly in light of the program's modest resources and the rapid pace of technology development. At the same time, the committee believes there are opportunities for further progress in two critical areas, which are briefly discussed in the next two sections.

INCREASED PRIVATE-SECTOR INVOLVEMENT

The committee was pleased to learn that the CAMP agreement has been signed, and work on three precompetitive research projects is under way. CAMP represents an important milestone in government–industry collaboration under the IVI program. The committee strongly supports such collaborative efforts as a productive way of engaging with industry in precompetitive research to help resolve safety issues before regulation is required. However, the current collaboration exists largely at the project level. There is little shared vision on program goals or resource allocation and minimal interaction at the senior management level on how industry and government can best work together.

At the committee's fourth meeting, held in Dearborn, Michigan, in December 2000, industry vice presidents voiced their preference for a more collaborative, joint governance arrangement and stated their willingness to take a more active role in developing such a structure. Joint governance does not imply loss of government control. Rather, the parties can control their own resources while working together to define mutually acceptable program goals and priorities.

Finalization of the CAMP agreement and the recent change in administration in Washington provide an opportunity for reengaging with industry and revisiting the IVI governance structure. **The committee believes DOT should take advantage of the occasion, and urges senior agency management to make the first overture by contacting senior managers in the automotive industry.** The committee suggests that some aspects of the governance structure of the Partnership for a New Generation of Vehicles (PNGV) could offer a model for a more collaborative arrangement. PNGV has a multilevel structure: technical teams of industry and government members operate at the project level; industry directors and agency midlevel managers manage the teams; and industry vice presidents and senior agency managers set program policy and overall direction.

Meaningful engagement at the senior management level requires a continuing dialogue. The Light Vehicle Steering Committee organized under the Intelligent Transportation Society of America (ITSA), which operates as a federal advisory

committee for the program, provides one setting for such an activity. **The committee does not think that working through the ITSA Steering Committee is sufficient, but believes that the likelihood of high-level government–industry dialogue would be enhanced by bringing the parties together in a neutral, third-party setting.** Options include an automotive center at a university, a foundation,[7] or a roundtable at the National Research Council organized expressly for this purpose.[8]

LEADERSHIP IN HUMAN FACTORS

The salient characteristic of many IV technologies is their interaction with the driver. For safety enhancing technologies, warnings need to be accepted as valid; therefore, false alarms should be rare. Warnings should also be timely, sequenced by urgency, and well understood by the driver so that appropriate crash avoidance action can be taken. For safety impacting technologies, whose primary purpose is driver convenience and comfort, the objective is to minimize adverse effects on safety; the technologies should not distract the driver or interfere with the driving task. In both cases, the behavior of the driver is crucial to the proper functioning of the technology. Thus human factors issues that address human–technology interaction are central to the IVI program.

The committee is pleased that a human factors expert has been added to the IVI program management in an effort to better coordinate human factors research within the program. However, this individual manages the IVI human factors program in addition to his responsibilities at the National Highway Traffic Safety Administration and leads a team that provides only part-time support. The committee is therefore concerned that the team may not be able to follow through on its ambitious agenda.

The committee recommends that the IVI human factors team be provided the resources necessary to ensure that the IVI program can assume a leadership role in the human factors arena. The team leader should also have a role in determining the allocation of program resources. With a more robust budget, the team would have the ability to fund the critical naturalistic driving study more adequately,[9] and to accelerate the development of evaluation protocols that could be used to measure the effects of a wider range of IV technologies on driver behavior. It would also become possible to conduct more extensive studies of IV technologies that are already

[7] For example, the Eno Foundation for Transportation could sponsor such a group.

[8] National Research Council roundtables are intended solely to enable dialogue and discussion among key leaders and representatives in a particular field. Because roundtables are not subject to the restrictions of the Federal Advisory Committee Act (e.g., committee composition and balance requirements, open meetings), they are prohibited from providing advice or recommendations or publishing reports (NRC 1999).

[9] Currently DOT is funding nearly 70 percent of the $3.2 million initial phase of the study; the other funders are Virginia Tech and the Virginia Department of Transportation. Total project costs will be significantly larger. The initial phase will involve design and analysis of information on crash behaviors for a pilot test including only 10 police-reported rear-end crashes. This phase will also involve design of a follow-on large-scale experiment.

commercially available.[10] Finally, implementing this recommendation would help ensure that the human factors team can integrate its work even more closely with that of the engineering teams at each stage of technology design, testing, and evaluation so that key human factors issues can be identified early in the technology development process.

PROGRAM FUNDING AND ALLOCATION OF RESOURCES

The IVI program is funded at a modest level relative to some other government–industry collaborative efforts. In recent years, annual federal funding for the IVI program has reached approximately $25 million. In comparison, annual federal funding of such government–industry initiatives as PNGV is several hundred million dollars.

As part of its task, the committee was asked to comment on the general deployment of IVI program resources and their allocation across the platforms. With so many different ways of defining the program [e.g., by platform, by generation (system complexity), by technology (safety enhancing, safety impacting)], the committee has found it difficult to determine how resources have actually been deployed.

The problem is exacerbated by the existence of cross-cutting issues that affect many activities. For example, IVI program staff had difficulty identifying the resources expended on human factors within the program.[11] The committee recognizes that some of the problems addressed by the program, such as driver distraction, are significantly larger than the program could reasonably be expected to address given its current budget. Here too, though, it is difficult to determine which aspects of the problem are being addressed by the program and which by others. **The committee recommends that in the future, an even more simplified budget format be developed for external use that facilitates the identification of major spending categories (e.g., human factors) and spending by crash problem area. A simple graphical representation of the basic elements of the IVI program, recommended in the committee's second letter report, would be a good place to start.**

With regard to the allocation of resources across the platforms, the committee observed that during the first 3 years of the program, DOT partnered primarily with commercial vehicle manufacturers and with a state department of transportation in the specialty-vehicle area [the exception being the General Motors (GM)/Delphi rear-end collision avoidance field operational test]. Greater emphasis has recently been placed on the light-vehicle area, primarily because of the addition of a new field operational test for a road departure collision avoidance system that should be awarded in mid-2001.[12] The other major field operational test in the light-vehicle area—the GM/Delphi project—will reach a critical point in September 2001, when a decision will be made on whether to

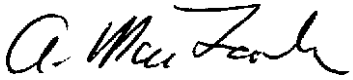
[10] For example, an evaluation of the effect of the Cadillac infrared night vision system on driver performance has been undertaken, but only one vehicle has been studied.
[11] Estimates ranged from 30 to 50 percent of total program funds.
[12] According to DOT, approximately two-thirds of fiscal year 1998–2002 IVI authorizations are for the light-vehicle platform. Of course, this number depends on many assumptions concerning the allocation of cross-cutting activities.

proceed to the actual test phase. Much can be learned from the commercial- and specialty-vehicle field tests; however, greater attention to the light-vehicle platform is appropriate given that passenger vehicles account for the preponderance of crashes.

CLOSING REMARKS

The committee has appreciated the opportunity to review and comment on the IVI program. Thanks are due to the program staff for the time taken to provide briefings at the committee's meetings and for their responses and responsiveness to the committee's comments and recommendations. We look forward to seeing the progress and products of this important initiative as the program matures during the next several years.

Sincerely,



Alexander MacLachlan
Chair, Committee for the Review
of the Intelligent Vehicle Initiative

References

Abbreviations

JPO Joint Program Office
NRC National Research Council

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