

# Challenges in Defense Conversion: Intelligent Transportation Systems as a Case Study

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The demise of the cold war sparked an intense debate as to the feasibility of converting formerly defense-dependent, high technology companies to civilian or dual-use endeavors. Recently this topic has been linked to transportation, as many of these companies have identified potential transportation applications of their technology developed under defense sponsorship. Past attempts to diversify and a review of the literature indicate, however, that this transition is neither automatic nor easily accomplished, in part because of nontechnical barriers in the areas of technology transfer, organizational culture, marketing, and finance. Using the emerging domain of Intelligent Transportation Systems (ITS) as a case study, nontechnical barriers to this transition are reviewed. Drawing on a series of lengthy telephone and personal interviews with defense company leaders and the recommendations gleaned from a joint industry-public sector executive panel, this study addresses two questions: what are the specific barriers faced by defense companies entering the ITS and transportation market, and what is the appropriate industry and public sector response to these challenges? In discussing these issues, the conclusion is reached that the defense industry is making progress toward overcoming difficult barriers to entry into the ITS domain; however, continued formation of a public-private partnership with DOT and other transportation officials is needed to provide far-reaching transportation benefits.

The demise of the Cold War signaled for many defense-dependent high technology firms a new sort of conflict: the battle for corporate survival. In the sociopolitical thaw that has followed, one of the most frequently debated topics is the feasibility of conversion or diversification of previously defense budget-dependent U.S. companies. The impetus behind this debate is a recognition that resident within these defense firms is a technological base proven in its ability to defend our nation, but also bearing promise of applications to pressing national needs. Transportation infrastructure revitalization and enhancement represents one such prominent need. Technologies such as Global Positioning Systems (GPS), advanced electronics, communications, and surveillance systems have been identified by defense companies and the public sector alike as potential solutions to mobility and safety problems (1). The quest for economic vitality similarly heightens the desire to put the resources embodied in these companies to work on providing significant transportation improvements.

Past experience and recent reviews of the literature indicate, however, that this transition is neither automatic nor easily accomplished. The literature is rife with examples of well-publicized conversion failures in previous periods of defense downsizing (2,3). What these examples illustrate, however, is not necessarily the inap-

propriateness of the technology being applied to new problems, but rather a number of difficult nontechnical barriers faced by these organizations, which are hindering their progress.

The emerging domain of Intelligent Transportation Systems (ITS) represents a case study in which to examine this theory. Jump-started by federal dollars and initiative, the ITS program has grown from a mere \$4 million in funding in fiscal year 1990 to a budget of nearly \$227 million in fiscal year 1995. Beyond federal involvement, a burgeoning ITS market and industry is beginning to take shape. Some optimistic futurists even project an anticipated market of \$200 billion over the next 20 years (4).

The lucrative promise of a vast commercial marketplace and the natural fit between the technology-intensive ITS arena and defense company expertise in these areas, as well as a rich history of systems integration and test and evaluation experience, have led many companies to demonstrate interest. However, the synergy between these talents and ITS national program needs has not been ensured, because of a number of nontechnical barriers earlier alluded to. For example, many defense company leaders report a lack of understanding of their new customers, who differ greatly from the single-point Department of Defense (DOD) buyer they shaped their businesses around. Likewise, whereas performance once superseded cost in the defense environment, in the transportation sector cost is a critical driver of investments and acquisition. In addition, many companies themselves are burdened with cost structures inappropriate for nondefense and commercial markets, as well as risk-averse corporate cultures fostered over decades of a relatively steady defense market. Similarly, this repositioning is taking place against a backdrop of an extremely dynamic public policy environment in which the relationships between industry and government, and the respective roles each must play to achieve the goals of improving the nation's transportation infrastructure, are being reevaluated. Nowhere is this more true than in the domain of ITS, in which a true public-private partnership is deemed necessary to achieve full deployment.

Through SRI's analysis, the barriers faced by defense companies as they position themselves for entry into the ITS marketplace can be grouped into a four-pronged framework of technology transfer, organizational culture, marketing, and finance. The desire to identify and qualify specific barriers in these categories led to the commission of a SRI International study, which filled in the gaps of existing research and used ITS as a case study to examine the possible barriers faced in other conversion efforts, perhaps with lessons for other modes (5).

Sponsored by the FHWA and the Volpe National Transportation Systems Center (VNTSC), the first phase of the study involved a

combination of survey and field research, as SRI conducted a literature review and then held over 35 interviews with defense company leaders and in-depth focus groups. The interviews included a series of telephone conversations as well as on-site interviews with three representative firms. SRI then convened an executive industry panel for a 1-day joint session with DOT officials on May 25, 1994 at SRI's Washington, D.C. office. The purpose of this meeting was to establish a dialog between key industry representatives, validate barriers uncovered in the telephone and focus group interviews, and examine possible next steps. Indeed, the focus throughout was to address two questions: what are the specific barriers faced by defense companies entering the ITS and transportation marketplace, and what is the appropriate industry and public sector response to these challenges? The recommendations for appropriate actions suggested by the joint industry-public sector executive panel are described in this paper. The conclusion is likewise reached that significant progress is being made in overcoming these barriers, although continued building of a public-private partnership between industry and DOT is needed to provide far-reaching transportation benefits envisioned by both sectors.

## CASE STUDY METHODOLOGY

### Literature Review

An internally funded SRI assessment of the literature formed the baseline information for the study. Before DOT sponsorship, SRI reviewed the most recent literature on general defense conversion topics as well as more focused materials specific to the transportation and ITS sectors. The amount of information concerning this topic has rapidly increased, as SRI discovered in its compilation of a source list (6). Articles related to the study topic that were monitored by SRI roughly doubled in number during January to September of 1993 when compared with the 12-month period of 1991 to 1992. A portion of this increased coverage was due in part to the keen attention given to the federal government's Technology Reinvestment Project (TRP), with its related dual-use focus. As part of the literature review, SRI also examined specific assessments of defense companies and their diversification strategies, which generally covered the relationship of defense conversion to transportation (7,8). However, none of the previous research identified non-technical barriers to entry specifically within the ITS context.

### Telephone Interviews

The first phase of the study included telephone interviews of defense company leaders. The approach was qualitative and the questions were largely open-ended, designed to identify the general issues and specific barriers faced by these companies as they prospected for new market opportunities in the ITS domain. The interview sample of 10 companies was drawn from a population of the top 100 defense prime contractors based on fiscal year 1992 award amounts. This interview sample represented companies whose revenues accounted for nearly 15 percent of the total Research, Development, Testing, and Evaluation (RDT&E) budget of the DOD in fiscal year 1992, which totaled \$121.4 billion (9). To ensure candid responses, SRI agreed to hold confidential the identities of companies and company leaders that participated in the interviews.

In addition to being drawn from the top 100 contractors, the interview sample was selected on the basis of several key criteria. These criteria included geographic location, wherein selected firms had a major operation in at least one of the eight geographic regions where defense cutbacks are likely to have the most impact (1), indication of interest in ITS (demonstrated by membership in ITS AMERICA, the primary ITS association, or appearance on bidders or awards lists of ITS-related projects solicited by FHWA), and potential to be responsive to the technical requirements and identified user services of ITS (10).

A structured interview guide was developed, and company leaders in each of the 10 companies participated in a telephone interview, conducted December 1993 through February 1994. The 14 study respondents, whose average length of service in their companies was 19 years, were primarily senior-level managers. Three included "ITS Program Manager" as part of their titles. At least one company leader in each organization was asked to provide his or her observations in five areas relating to the ITS and transportation marketplace, including organizational approach, information networks utilized, public-private partnerships, procurement responses, and industry impressions.

### Perceived Barriers

The telephone interviews revealed a number of barriers, as well as opportunities for change. Foremost among the perceived barriers and opportunities were the following:

1. Most companies have only recently become involved in ITS and their targets are largely driven by existing core competencies, instead of market pull.
2. An interdisciplinary approach to entry into ITS is being taken, although corporate coordination and organization appears loosely structured.
3. Corporate commitment to ITS is currently tentative, in part because of what is perceived as an undefined and long-term market. Many managers are reluctant to invest in ITS without returns on investment within a few years, according to the respondents.
4. One-way information channels (reports, press coverage) are rated as minimally useful in terms of providing information.
5. Two-way channels (networking, conference attendance) are more productive, although there was a mixed view of the usefulness of some conferences and ITS AMERICA (the primary ITS association) committee participation.
6. Interactions with federal, state, and local transportation agency officials are quite useful and help in understanding the demands of the new ITS domain.
7. Team formation and partnering is necessary for success but should be company initiated.
8. Major differences exist between FHWA and DOD solicitations, and respondents understand little about FHWA's procurement processes.

In addition to these specific barriers, respondents also indicated that their key impressions about the current state of the ITS program centered around the need to sustain ITS program momentum by maintaining a strong federal presence. Similarly, they felt that a technology infusion was needed in federal, state, and local transportation agencies. Respondents thought transportation officials with technical training in advanced technologies would facilitate

communication and enable the best products to be deployed. The respondents also commented on the importance of addressing financial barriers such as cost-share and no-fee provisions in federal solicitations. These requirements are difficult to justify to upper management, which does not see an immediate payoff. Finally, the need for enhanced outreach with a regional orientation was voiced as another important concern.

### On-Site Interviews and Focus Groups

Drawing from their responses, SRI shaped the questionnaire for in-depth focus groups and on-site interviews. The objective for these series of interviews was to go beyond the specific, tactical barriers identified in the telephone interviews to a broader understanding of how ITS was fitting into overall corporate diversification strategies and to ascertain whether the identified barriers still held true. This second phase consisted of on-site visits to three companies, representative of the population under study, which included aerospace, electronics, and engineering companies. Each selected company had yearly revenues of \$5 to \$10 billion and major operations in one or more of the eight states most affected by defense cutbacks (1). Lengthy interviews based on an interview guide were held with an average of six company leaders per company, representing technical managers, business development leaders, and corporate officers.

One of the most striking characteristics of the on-site focus groups was the willingness to share their observations on the challenges they face in repositioning themselves, in what is generally a closed and cautious environment. The issues of conversion and their

relationship to the transportation marketplace appeared to be of great interest. General characteristics of the three companies studied appear in Figure 1.

### Major Findings from Interviews and Focus Groups

From our analysis of the data collected in both the telephone and focus group interviews with defense company leaders, it appears that many intriguingly similar barriers to entry are facing the industry as a whole. However, we are limited in our ability to generalize across the industry because of the relatively small sample size. From the data, however, one fact did become particularly clear: both defense companies and the public sector, to include DOT, have the opportunity to actively reduce barriers within their respective spheres of influence. The challenge appeared to be twofold, with both industry-based and public sector-influenced barriers comprising the complete picture. The barriers most highly emphasized in both the case studies and the interviews are summarized below.

### Industry-Based Barriers

1. Market unfamiliarity: defense companies lack knowledge of nondefense government procurement processes and evaluation criteria and have little or no experience in dealing with multiple customers and users.

2. Technology push orientation: many defense companies are committed to high-technology solutions in marketplaces with different requirements.

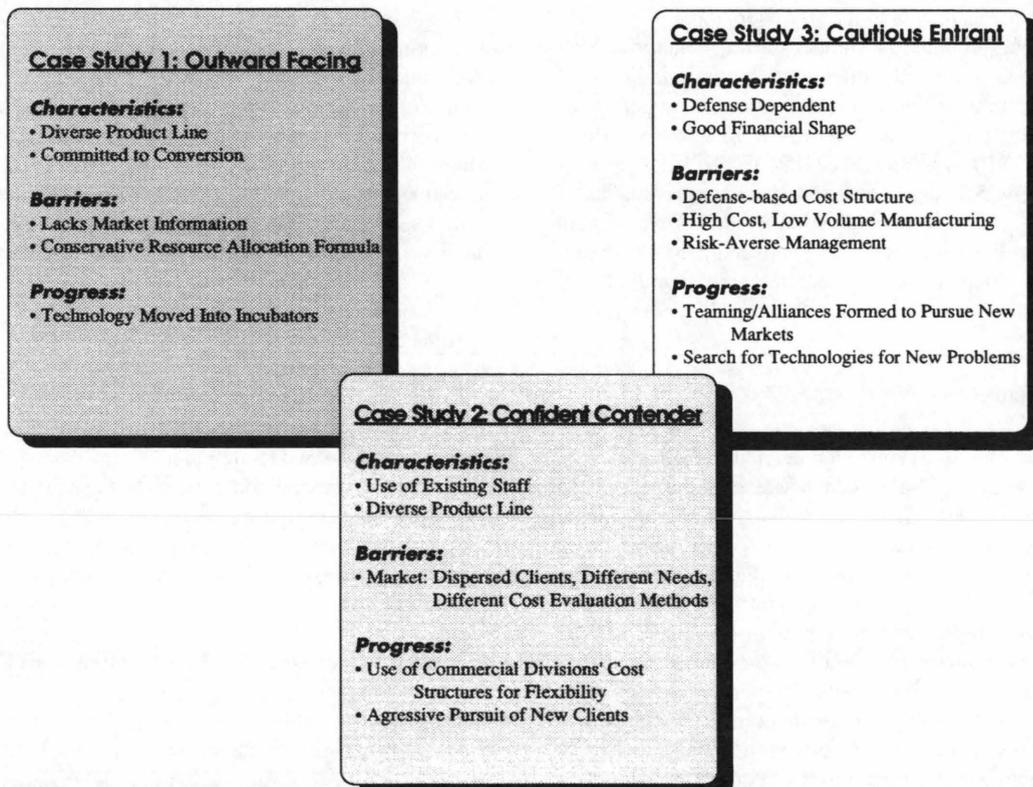


FIGURE 1 Excerpts from on-site interviews.

3. Risk-averse culture: these organizations have a tradition of low risk approaches and caution in the marketplace; they likewise lack internal transportation domain knowledge and expertise.

4. Financial constraints: companies retain defense-configured financial infrastructure with high overheads and little flexibility.

### **Public Sector-Influenced Barriers**

1. Closed communication channels: many respondents indicated that they felt programmatic information on ITS projects and plans were filtered and dissemination modes limited. They likewise saw a shortage of opportunities to interact with customers and users and expressed a desire for enhanced dialog.

2. Technology gap: many company leaders perceived a lack of in-house technological sophistication on the part of the public sector, as well as few standards and protocols that will reduce market risk and enable defense companies to more readily pursue ITS markets.

3. Industry knowledge lacking: many public sector representatives exhibited little understanding of how the defense industry operates, according to the respondents.

4. Cost Requirements: federal solicitation requirements are often incompatible with business practices, particularly cost-share and no-fee provisions in situations such as system integration projects, in which no commercially marketable product will result.

### **Industry-DOT Executive Panel**

A starting point for the panel session involved drawing from the above framework established in the first phase of the study, with its corresponding public sector-influenced and industry-based barriers. For the panel, refinement included distilling the findings into a simplified framework for use as a template in the panel discussion. The four-pronged template of technology transfer, organizational culture, marketing, and finance adequately captured the comments garnered in the interview and focus group process. On May 24, 1994 at SRI's Washington office, a joint industry-DOT panel met to (a) establish a dialog, (b) discuss and validate the barriers identified in the first phase of the study, and (c) explore the next possible actions. The sort of frank exchange envisioned by SRI and the DOT sponsors required identification of appropriate individuals for the discussion and a format for the meeting that would facilitate this openness.

### **Panel Selection and Panelist Qualifications**

The selection of industry candidates was based on similar criteria to that used in the first phase of the study. Drawn from the pool of the top 100 defense prime contractors, the panelists represented a varied spectrum of involvement in the ITS program (as evidenced by ITS AMERICA membership, appearance of FHWA bidder's lists, etc.). Although some industry panelists represented companies that participated in the first phase of the study through the survey interviews and focus groups, several new company leaders represented their organizations on the panel. As a group, the represented companies formed a broad mix in terms of defense dependency (determined as a ratio of defense to nondefense corporate revenues) and business sector, including advanced electronics, aerospace, and information services.

In terms of the industry panelists' personal qualifications, SRI primarily targeted the director and vice presidential levels for the eight industry representatives. Selection was based on inviting panelists who could articulate the broad strategic views of their organizations, and who likewise had a knowledge of corporate culture and financial resources. Selected panelists' professional responsibilities included strategic planning and analysis as well as corporate marketing and technical management.

The seven public sector representatives from DOT mirrored this composition, including program managers from the ITS program at DOT headquarters and the research and development divisions, as well as representatives from the director and associate administrator levels. In keeping with the intermodal nature of ITS, representatives from both FHWA and FTA were present. The balance among public sector and private industry representatives allowed for a sound foundation to begin an exploratory dialog on the salient issues involved in defense conversion, within the context of an emerging ITS market.

### *Agenda and Proceedings*

The agenda included a review of the SRI study and a group dialog on key ITS challenges and barriers for defense companies, using the identified template. This discussion was followed by forming small brainstorming groups to expand the vision of opportunities and identify priority issues. An attempt at action planning closed out the discussion and formed the basis for a series of recommendations.

Underscoring both of these discussions was a sense of urgency on the part of the defense industry. In an environment of intensified downsizing of the defense segments of their companies, company leaders greatly desired the ability to quickly employ the resources embodied in their people and technology before these were lost. This desire to retain and fully utilize these vast resources was woven into many of the comments identified below.

### **Panel Validation of Barriers**

The themes from the panelists' comments are clustered around the template described earlier, which uses the core categories of technology transfer, organizational culture, marketing, and finance.

### *Technology Transfer*

Technology transfer in the context of this panel meeting did not refer to core competencies but rather connoted the movement toward commercialization of technology within the defense company or defense portion of the company. Although this sort of transfer is a difficult process, several defense companies are dealing with the issue. Many of the industry panelists represented defense companies that also had large and profitable commercial divisions. In those companies, technologies developed for defense applications but with commercial possibilities were being transferred to commercial divisions for manufacturing and sale. The sentiment expressed was that only commercial divisions could provide high volume, low cost production competitively.

The panelists also indicated some struggles to apply to their technologies and capabilities to specific markets, whether commercial or nondefense government. This was especially true in the context

of ITS, in which panelists asserted that valuable technologies remained buried within their companies and that requests for new ways to solve a particular problem would help uncover these technologies. In light of this, many panelists called for acceleration of the matchmaking process between existing technology and problems or needs in the ITS arena.

Furthermore, company leaders voiced the belief that a definite advantage exists for DOT to continue its proactive role in enabling this matching process. If defense companies can see how technologies latent within their organizations can apply to ITS or transportation problems, they can write compelling TRP proposals. DOT gains by expanding their development and demonstration effort through leveraging TRP funds. This scenario also applies to tapping into the reservoirs of additional funds under the rubric of defense conversion or dual-use.

The other aspect of this issue was captured as the realization that programmatic understanding of ITS (i.e., familiarity with the ITS user services without in-depth knowledge) was not thorough enough to guarantee application of appropriate technology to all the necessary ITS needs. Comments made throughout the day suggested the efficacy of public sector visits to companies and formalized exchanges on key problems looking for cost-effective technical solutions. The overriding concern about having potential solutions and not knowing enough about the problem to explore application of these solutions was expressed frequently.

In both of these issues, including transfer of technology to other nondefense agencies and leveraging other sources of funds, one mutually agreed-on belief was the importance of having a federal program in ITS. This echoed the views expressed in the telephone interviews. The industry panelists were in agreement that their companies would not be pursuing technology transfer to other government agencies or in commercial marketplaces without clear government leadership and direction.

### *Organizational Culture*

During the panel discussion, management issues and barriers were expanded into a broader aegis of organizational culture. The primary issues became rooted in the nature of relationships: primarily relationships with the new customer, but also including newly emerging public-private alliances.

According to the panelists, the defense culture is not tailored to the proclivities of their newfound dispersed customer base, which includes not only federal officials, but state and local stakeholders as well. Even Congress becomes a customer to satisfy, as one DOT representative pointed out, and the shortcoming in many traditionally defense-oriented companies is a tendency to tell, not show, when describing the benefits of a new technological advance. Many agreed that the power of demonstrated technology extends much further than verbal claims to exciting new products and ideas. This wisdom becomes even more important as these companies approach their ultimate customer and user-base: the driving public.

Other relationships that remain awkward fall under the category of public-private partnerships. In this era, when "industrial policy" is often espoused, many panelists expressed a degree of discomfort with the new relationships emerging between industry and government. Much of this may be because of an unfamiliarity of working partnership models, as well as lacking knowledge of their new ITS customers' needs. Industry panelists also pointed out that government officials responsible for shaping policies which govern these

new partnerships lacked in-depth understanding of how companies operate, as was suggested in the telephone and focus group interviews. The need for formalized education and opportunities for exchange was mentioned again within this context.

### *Marketing*

Two issues raised in relationship to technology transfer appeared again in the discussion of current and potential markets for ITS, including the importance of federal momentum and the incompleteness of technology matches with market needs.

According to the panelists, one of the key factors in making a corporate investment decision is lack of market risk, since the company wants to assure themselves that they are not too far in front of the market. In essence, they begin to focus on the shape of a new ITS market and the resulting businesses developed to serve that market. This perception led to the introduction of two new issues during the meeting. The first involved the timeliness of the system architecture effort as well as standards development. Secondly, several defense industry panelists discussed their process for selecting new commercial markets to pursue.

Two efforts underway at DOT and within the committee structure of ITS AMERICA are standards development and the systems architecture projects. Both can contribute in a major way to reducing the market risk to industry. The defense industry, however, has a keen sense of urgency and immediacy as earlier stated. They would like to see all these efforts accelerated to provide market opportunities immediately—not many years from now, as some might predict.

To this end, concentration on standards for interconnectivity was stressed and enthusiastically endorsed by several industry panelists. However, there was not a complete consensus. In a discussion focused on electronic toll collection, one company leader argued for desirability of interconnectivity, particularly for interstate or multi-jurisdictional travel. Another individual challenged the necessity of accelerating interconnectivity because he saw the lack of standardization as an immediate opportunity for his company to develop the technology to convert a toll card into a usable form for many systems. To this particular panelist, interconnectivity in this case could close off a potential market.

Nevertheless, interconnectivity was brought forth frequently as an important issue to address quickly in order to reduce market risk for defense companies eager to develop ITS products. Likewise, the systems architecture effort was reviewed with similar urgent requests to accelerate the process. One panelist suggested that the critical decisions would be made early on and that if this is the case, quick dissemination of the results would be helpful to industry leaders as they deal with determining what the market will bear.

The second new topic was not only specific to the defense industry but may have broader implications. When an industry such as the defense companies represented by the panel contemplates the ITS market, ultimately they are not concentrating on selling to the government. Rather, they are thinking about creating a new business. This new ITS business is by no means a monolithic enterprise. Developing an ITS industry in information services, vehicle components, or for infrastructure-based systems requires different operating models. How to create these different models and comprehend the barriers and opportunities inherent in each is vital to both a successful ITS program and all forms of resultant industry. The role of the federal government in understanding how the new ITS business

may be shaped is a key to reducing market risk, which when unmitigated, can make for reluctant investors.

### Finance

The insights captured under this element differed most from the comments uncovered in the initial telephone interviews. The results of these interviews portrayed financial concerns primarily in tactical terms of government cost share requirements not being consistently applied and inappropriate no-fee situations. In terms of strategic planning, respondents indicated that the market was perceived as too long-term to justify cost sharing, especially to upper management looking for immediate returns on investment. The on-site focus groups further clarified the strategic issues in finance. Two of the companies studied in those sessions defined lack of flexibility in their financial systems as being a problem. One of those companies had embarked on a new accounting system to rectify the situation.

During the panel session, many company leaders confirmed that there was indeed a lack of financial flexibility in the defense divisions of their organizations, including burdensome overheads. However, as the on-site focus groups suggested, several companies are attempting to address those problems. As mentioned under the technology transfer category, technology is simply moved out of defense divisions into commercial divisions experienced in distribution, pricing, and high volume production. According to many industry panelists, inflexibility was no longer a central problem.

What has emerged as a major focus is the question of whether the defense industry will make major investments in future ITS products and processes. As some may assume, the answer to this question is not dependent on the resources available within the company for such an investment. Two industry panelists asserted that if the market exists, their organizations would commit significant funds to develop, demonstrate, and commercialize ITS technology. Rather, the answer rests heavily on the perceived market risks of such a venture. Many panelists similarly believed that DOT has an important and appropriate role to play in reducing the market risk by helping to define the current and future ITS markets.

Another issue that surfaced in the focus group interviews and was further amplified in the panel meeting was the adequacy of financial models. The interviews elicited many comments related to company leaders' attempts to understand new funding mechanisms involved in public-private partnerships. Both government and industry panel members expressed a desire to better utilize those models and to identify best practices. A review of the possible models and verification of those that have been effective was deemed useful to the entire ITS stakeholder community.

### Recommendations

With respect to developing appropriate recommendations from the specific suggestions captured in the four-pronged template of technology transfer, organizational culture, market, and finance, the panelists articulated a potential vision for ITS. Underlying this vision was a focus on goals attainable through implementation of specific recommendations. These immediate goals as articulated by the panelists include the following:

1. Financial creativity;
2. Strong consumer economy and awareness;

3. Highly motivated, informed, and excited state and local government officials;
4. First generation architecture;
5. Sufficient standards to accelerate deployment; and
6. Defense technology players involved and integrated into the market.

The following recommendations suggested by the panel represent shared initiatives by both DOT and industry participants which can feed directly into realization of the emerging vision of ITS. However, they also represent only a possible sample of appropriate responses. Further evaluation is needed to determine which sector should take the leadership role in each of these areas.

The recommendations are categorized into three fields: education and outreach, sustaining ITS momentum, and finally, market risk reduction. These three fields can then be overlaid against the four-pronged basic template established to guide the panel discussion.

### Regional Outreach and Education

1. Provide access to financial models for state and local governments. One of the shortcomings articulated by the panel participants was a lack of working financial models to assure funding and deployment of important ITS technologies. Recommendations for improvement would include exploration of successful models used in industry in similar emerging high technology areas in order to develop a series of best practices which might be applied to the ITS domain. These best practices would be representative not only of public-private partnerships but also private-private partnerships. After identifying these practices, dissemination to state and local stakeholders in written form and perhaps accompanied by a workshop series with a regional orientation would be recommended.

2. Redefine financial and management roles and further explore privatization. Traditional public roles with respect to financing and operational management of ITS systems might be appropriately transferred to the private sector. This transfer may allow for improved services and may likewise stimulate the market opportunity of ITS technologies. Further exploration of privatization issues was suggested.

3. Arrange for DOT state and local visits to key companies on specific ITS-related technology areas or to investigate potential solutions to specific problems. Many industry panelists encouraged this sort of exchange as a valuable way to uncover a number of technologies suitable for application to needs resident within these public sector stakeholders' purview, as well as a method to continue interaction. Likewise, company leaders reaffirmed an openness and willingness to entertain such mutually educating visits.

4. Continue the process of matching defense companies' technologies to potential markets and cost-effective solutions to problems. Defense companies must maintain their proactive information-gathering processes on the shape and prospects of new markets. They must also continue examining the ways that their technologies can solve problems or provide advantages over existing systems to achieve the goal, as expressed by the panel, of full integration into ITS.

5. Instigate a series of state governors' meetings. In key states affected by the defense downturn, a meeting between corporate CEOs and other company leaders with that state's governor and staff, transportation officials, and others would serve many pur-

poses. Besides bringing visibility to the issue of the applicability of ITS as an economic stimulus with far-reaching social and infrastructure benefits, it would help facilitate dialog and provide a forum in which to exchange ideas. Moreover, it would sustain and perhaps increase momentum on the part of industry by involving upper management. The spinoff effects could include increased corporate investment and commitment.

#### *Sustaining ITS Momentum*

6. Leverage other federal funding sources such as TRP and state defense conversion assistance funds. The presence of the federal government in ITS is vital to the defense industry. To upper management in many of the companies represented by the panel, a federal presence provides the impetus for embarking on the difficult process of transferring military technology to a civilian environment. Similarly, if the defense industry understands how its core technologies can be applied to solving difficult transportation problems, they can also leverage the defense conversion funding that became available in fiscal year 1993 and is continuing at a minimum through fiscal year 1995 in the TRP.

Access to additional conversion assistance funds available at the state level may also be possible, representing a very real opportunity to leverage federal ITS investments for the benefit of increased transportation research and development. To do so, however, requires immediate understanding of dual-use opportunities on the part of defense companies, thus closely linking this particular recommendation to the education and outreach activities.

7. Generate excitement via technology demonstrations by the defense industry to state and local officials, Congress, and metropolitan planning organizations, among others. Just as the nation was awed by visual displays of sophisticated weaponry during the Persian Gulf War, the transportation community and its stakeholders can be equally impressed by potential dual-use technologies applicable to ITS. Demonstrations of technology are powerful and should be used with more regularity during the course of conferences and through other mechanisms.

8. Develop and build consumer awareness. Likewise, consumer awareness and excitement can be created by technical demonstrations. A number of other additional avenues in which to build consumer acceptance exist and are currently under study by DOT.

9. Tap into existing transportation associations. Defense companies can further their understanding of new markets such as ITS while at the same time cultivating an appreciation for the technology they have developed by reaching out to associations that represent state and local transportation officials and stakeholders. Associations gain similar benefits by expanding their membership to include these companies and their supplier community. Developing a connection to such organizations as AASHTO and actively participating in special sessions at ITS AMERICA and TRB annual meetings would be possible activities related to this recommendation.

10. Leverage operational tests and results. Operational tests represent a very real opportunity to showcase not only technology but innovative public-private partnerships and financial arrangements. Likewise, operational tests provide for increased market knowledge, state and local government buy-in, and development of consumer acceptance and interest. They also can create test beds in which to highlight defense companies' impressive systems integration and program management skills.

#### *Market Risk Reduction*

11. Promote an ITS industry using other emerging industries as models. ITS is certainly not a single, monolithic entity. The emergence of ITS will most likely spawn several new business areas never before in existence. This is a challenge to all companies involved in this evolution, including defense companies, small businesses, and traffic-engineering firms. Similar challenges are faced by their partners: federal, state, and local governments. Over the past decade, however, the creation of new businesses has occurred in other technological domains. Insights and usable models may be available from the computer, electronics, and biotechnology industries. Drawing on experiences from past emerging markets would allow DOT to spur the process of creating an ITS industry.

12. Explore barriers to new ITS businesses. Examination of the new businesses that do emerge as ITS evolves, and the barriers facing this evolution, would be particularly salient in light of the partnership existing between government and industry in this endeavor. Technological barriers as well as institutional and business-related challenges need to be defined and modeled in order to fully understand the risks and opportunities involved. These two topics relate closely to the roles of government and industrial policy, which some industry panelists felt made them particularly timely.

13. Encourage rapid development of appropriate interconnectivity standards. In principle this was generally accepted but careful selection of the topics is still necessary. A few panelists felt that market development could be accelerated greatly based on increased activity in this area.

14. Accelerate systems architecture development and dissemination of results. Many panelists called for the availability of systems architecture results as soon as is feasible. Thorough and timely dissemination of this work was deemed essential, particularly to those in the product development process.

#### **CONCLUSION**

The fourteen recommendations under the three fields of education and outreach, sustaining ITS momentum, and market risk reduction can likewise be captured under the four-pronged template that represents the critical components to overcoming barriers to full ITS deployment and integration. Figure 2 represents this overlay. These recommendations can form the building blocks of appropriate industry and public-sector responses in facing these barriers. However, evaluation is needed as to assignment of leadership roles in order to implement these recommendations. In its desire to establish a healthy and functioning public-private partnership, DOT and state and local officials may be required to proactively plan for and implement these recommendations. Defense company leaders have articulated a desire to participate and similarly lead as deemed appropriate.

In conclusion, after assessing the barriers faced by the major defense companies attempting to enter the ITS market (both observed by SRI and articulated by company leaders themselves), this study concludes that some progress is being made toward resolving these challenges in the four areas of technology transfer, organizational culture, marketing, and finance. This appears to be spurred on by many of the companies' own actions. However, several of the recommendations suggested in this report can facilitate and perhaps accelerate this course and provide an opportunity for DOT and other transportation agency officials to nurture the needed

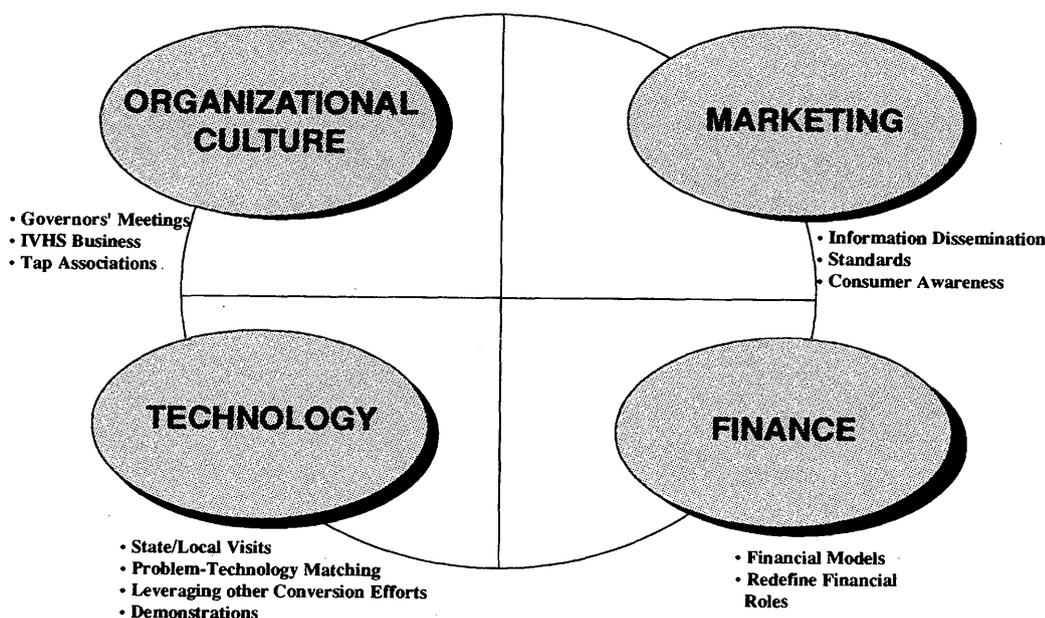


FIGURE 2 Four-pronged template with recommendations overlay.

public-private partnership. Certainly public-sector and industry collaboration in executing selected recommendations will build on the dialog established in the panel meeting and will further enhance this evolving relationship.

Additional analysis may be needed to bring into clear focus the shape and potential of this emerging paradigm for an evolving ITS business which will significantly affect the vitality of the nation's transportation system. However, the opportunity for DOT to be a leader and catalyst in this process is perhaps exactly what President Clinton articulated in his technology plan (11):

American technology must move in a new direction to build economic strength and spur economic growth. The traditional federal role in technology development has been limited to the support of basic science and mission-oriented research in the Defense Department, NASA, and other agencies. This strategy was appropriate for a previous generation but not for today's profound challenges. We cannot rely on the serendipitous application of defense technology to the private sector. We must aim directly at these challenges and focus our efforts on the new opportunities before us, recognizing that the government can play a key role helping private firms develop and profit from innovations.

The promises of an invigorated economy and productive repositioning of national resources lie implicit in the realm of ITS and will require commitment on the part of both public and private stakeholders to ensure the realization of this vision.

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